BHARATH INSTITUTE OF HIGHER EDUCATION AND RESEARCH

R-2018

CURRICULUM

School of Aeronautical Engineering

School of Aeronautical Engineering

- B.Tech - Aeronautical Engineering
- B.Tech - Aerospace Engineering

CURRICULUM AND SYLLABUS

(R2018)
B - FACT

(Bharath – **F**lexible **A**ccommodative **C**hoice based credit system for **T**echnology)

(Applicable to the batches admitted from July 2018)

B.Tech - AERONAUTICAL ENGINEERING

FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	3	3	0	0	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	2	0	0	2	0
8	*U18BSCH2L4	BS	Chemistry Lab	2	0	0	2	0
9	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	U18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
TOTAL				**31**	**18**	**1**	**12**	**21**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	3	0	0	3
2	U18BSMA201	BS	Engineering Mathematics-II	4	3	1	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	4	0	0	4	2
8	*U18BSCH2L4	BS	Chemistry Lab	4	0	0	4	2
9	U18ESME1L2	ES	Workshop / Manufacturing Practices Laboratory	3	3	0	0	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
11	18MCAB203	MC	Yoga	2	0	0	2	0
12	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
TOTAL				**37**	**20**	**1**	**16**	**27**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER III								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA302	BS	Partial Differential Equations and Probability & Statistics	4	3	1	0	4
2	U18PCAE301	PC	Fundamentals of Aeronautics and Astronautics	2	2	0	0	2
3	U18PCAE302	PC	Fundamentals of Mechanics and Machines	3	3	0	0	3
4	U18ESAE301	ES	Fundamentals of Fluid Mechanics	3	3	0	0	3
5	U18ESAE302	ES	Fundamentals of Aero – Thermodynamics	3	3	0	0	3
6	U18ESAE303	ES	Fundamentals of Structural Mechanics	3	3	0	0	3
PRACTICAL								
7	U18PCAE3L1	PC	Strength of Materials Laboratory	4	0	0	4	2
8	U18PCAE3L2	PC	Computer Aided Design and Drafting Laboratory	4	0	0	4	2
9	U18ESAE3L1	ES	Fluid Mechanics and Machinery Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
TOTAL				**34**	**17**	**01**	**16**	**24**

SEMESTER IV								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA401	BS	Numerical Methods	4	3	1	0	4
2	U18PCAE401	PC	Elements of Aerospace Structures	3	3	0	0	3
3	U18PCAE402	PC	Low Speed Aerodynamics	3	3	0	0	3
4	U18PCAE403	PC	Aircraft Propulsion	3	3	0	0	3
5	U18PCAE404	PC	Aircraft Systems and Instrumentation	2	2	0	0	2
6	U18PCAE405	PC	Manufacturing Technology	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	0	0	2	0
PRACTICAL								
8	U18PCAE4L1	PC	Aerodynamics Laboratory	4	0	0	4	2
9	U18PCAE4L2	PC	Manufacturing Technology Laboratory	4	0	0	4	2
10	U18PCAE4L3	PC	Aero Design and Modeling Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
TOTAL				**35**	**17**	**1**	**18**	**24**

SEMESTER V								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAE501	PC	Aircraft Structural Mechanics	3	3	0	0	3
2	U18PCAE502	PC	Gas Dynamics	3	3	0	0	3
3	U18PCAE503	PC	Advanced Aerospace Propulsion	3	3	0	0	3
4	U18PCAE504	PC	Aircraft Performance	3	3	0	0	3
5	U18PCAE505	PC	Control Systems	3	3	1	0	4
6	U18PEAE5E1	PE	Professional Elective – I	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	0	0	2	0
PRACTICAL								
8	U18PCAE5L1	PC	Aircraft Structures Laboratory	4	0	0	4	2
9	U18PCAE5L2	PC	Aircraft Maintenance Laboratory	4	0	0	4	2
10	U18PCAE5L3	PC	Flight Simulation Laboratory	4	0	0	4	2
11	U18PCAS5L4	PC	Simulation tool for Aerospace Applications	4	0	0	4	2
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
TOTAL				**40**	**18**	**1**	**22**	**27**

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSBA601	HS	Organizational Behavior	3	3	0	0	3
2	U18PCAE601	PC	Finite Element Analysis	3	3	0	0	3
3	U18PCAE602	PC	Aircraft Stability and Control	3	3	0	0	3
4	U18PEAE6E2	PE	Professional Elective – II	3	3	0	0	3
5	U18OEAE6E1	OE	Open Elective – I	3	3	0	0	3
6	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	0	0	2	0
PRACTICAL								
7	U18PCAE6L1	PC	Computer Aided Analysis Laboratory	4	0	0	4	2
8	U18PCAE6L2	PC	Propulsion Laboratory for Aeronautical	4	0	0	4	2
9	U18EEAE6L1	EE	Aircraft Design Project – I	4	0	0	4	2
ACTIVITY BASED COURSES								
12	U18MCAB609	MC	Social Services – Social Awareness	2	0	0	2	0
13	U18MCAB610	MC	Social Services – NSS	2	0	0	2	0
TOTAL				**33**	**15**	**0**	**18**	**21**

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAE701	PC	Computational Fluid Dynamics for Aerospace Engineering	3	3	0	0	3
2	U18PCAE702	PC	Introduction to Avionics	3	3	0	0	3
3	U18PEAE7E3	PE	Professional Elective – III	3	3	0	0	3
4	U18PEAE7E4	PE	Professional Elective – IV	3	3	0	0	3
5	U18PEAE7E5	PE	Professional Elective – V	3	3	0	0	3
6	U18OEAE7E2	OE	Open Elective – II	3	3	0	0	3
PRACTICAL								
7	U18PCAE7L1	PC	Avionics Laboratory	4	0	0	4	2
8	U18EEAE7L1	EE	Aircraft Design Project – II	4	0	0	4	2
9	U18PRAE7P1	PR	Project Phase I	4	3	0	0	3
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioral and Interpersonal Skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
TOTAL				**34**	**21**	**0**	**12**	**25**

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PEAE8E6	PE	Professional Elective – VI	3	3	0	0	3
2	U18OEAE8E3	OE	Open Elective – III (MOOC)	0	0	0	0	2
3	U18OEAE8E4	OE	Open Elective – IV	3	3	0	0	3
PRACTICAL								
4	U18PRAE8P2	PR	Project Phase II	18	0	0	18	9
5	U18EEAE8C1	EE	Comprehension	0	0	0	2	1
ACTIVITY BASED COURSES								
6	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL				**26**	**6**	**0**	**22**	**18**

Total No. of Contact Hours : 270 Hours

Total No. of Credits : 187

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

Sl. No.	Category of Courses	Semester wise Credits								No. of Credits	% of Credits
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences (HS)	3	3	-	-	-	3	-	-	9	4.8
2	Basic Sciences (BS)	10	16	4	4	-	-	-	-	34	18.18
3	Engineering Sciences (ES)	8	8	11	-	-	-	-	-	27	14.43
4	Professional Core (PC)	-	-	9	20	24	10	8		71	37.96
5	Professional Electives (PE)	-	-	-	-	3	3	9	3	18	9.62
6	Open Electives (OE)	-	-	-	-	-	3	3	5	11	5.88
7	Employability Enhancement (EE) Courses: Technical Seminar, Internship, Term Paper, Comprehension, etc.	-	-	-	-	-	2	2	1	5	2.67
8	Project Work, (PR)	-	-	-	-	-	-	3	9	12	6.41
9	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	-	-
Total Credit		21	27	24	24	27	21	25	18	187	100
Total Contact Hours		31	37	34	35	40	33	34	26	270 Hours	

LIST OF ELECTIVES

List of Professional Elective(PE) I:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE011	Maintenance	Aircraft General Engineering and Maintenance Practices	3	0	0	3
U18PEAE012	Propulsion	Rockets and Missiles	3	0	0	3
U18PEAE013	Aerodynamics	Experimental Aerodynamics	3	0	0	3
U18PEAE014	Aerodynamics	Boundary Layer Theory	3	0	0	3

List of Professional Elective (PE)II:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE021	Maintenance	Civil Aviation Regulations	3	0	0	3
U18PEAE022	Structures	Theory of Elasticity	3	0	0	3
U18PEAE023	Propulsion	Principles of Turbo machinery in Air breathing Engines	3	0	0	3
U18PEAE024	Materials science	Aircraft Materials	3	0	0	3

List of Professional Elective (PE) III:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE031	Maintenance	Vibrations and Elements of Aero elasticity	3	0	0	3
U18PEAE032	Structures	Aircraft Engine Repair and Maintenance	3	0	0	3
U18PEAE033	Propulsion	Missile Aerodynamics	3	0	0	3
U18PEAE034	Materials science	Hypersonic Aerodynamics	3	0	0	3

List of Professional Elective (PE) IV:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE041	Propulsion	An Introduction to Combustion	3	0	0	3
U18PEAE042	Materials science	Nano Science and Technology	3	0	0	3
U18PEAE043	Maintenance	Airport Engineering	3	0	0	3
U18PEAE044	Structures	Theory of Plate and shell	3	0	0	3

List of Professional Elective (PE) V:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE051	Materials science	Composite Materials and Structures	3	0	0	3
U18PEAE052	Structures	Experimental Stress Analysis	3	0	0	3
U18PEAE053	Maintenance	Helicopter Maintenance	3	0	0	3
U18PEAE054	Propulsion	Heat Transfer in Aerospace Applications	3	0	0	3

List of Professional Elective (PE) VI:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE061	Materials science	High Temperature Materials	3	0	0	3
U18PEAE062	Structures	Fatigue and Fracture Mechanics	3	0	0	3
U18PEAE063	Propulsion	Cryogenic Rocket Propulsion	3	0	0	3
U18PEAE064	Structures	Structural Dynamics	3	0	0	3

List of Open Electives

Code No.	Specialization	Course Title	L	T	P	C
U18OEAE001	Aerodynamics	Industrial aerodynamics	3	0	0	3

U18OEAE002	Engineering science	Elements of Aeronautics and Astronautics	3	0	0	3
U18OEAE004	Structures	Unmanned Aerial Vehicle	3	0	0	3
U18OEAE003	Avionics	Avionics systems	3	0	0	3
U18OEAE005	Propulsion	Rocket propulsion	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations

20 U18OECE003-Road Safety

21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics

38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS001-Mobile Application Development
72. U18OECS002-System Modelling and Simulation
73. U18OECS003-Web Programming
74. U18OECS004-Virtual Reality
75. U18OECS005- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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LIST OF COURSES UNDER HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT STUDIES (HS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	HS	Communicative English	3	3	0	0	3
2	U18HSEN201	HS	Technical English	3	3	0	0	3
3	U18HSBA601	HS	Organizational Behavior	3	3	0	0	3
TOTAL				9	9	0	0	9

LIST OF COURSES UNDER BASIC SCIENCE COURSES (BS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
	U18BSMA201	BS	Engineering Mathematics-II	4	3	1	0	4
	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
	U18BSMA302	BS	Partial Differential Equations, Probability and Statistics	4	3	1	0	4
	U18BSMA401	BS	Numerical Methods	4	3	1	0	4
PRACTICAL								
	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	4	0	0	4	2
	*U18BSCH2L4	BS	Chemistry Lab	4	0	0	4	2
TOTAL				38	26	4	8	34

LIST OF COURSES UNDER ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
	U18ESME101	ES	Engineering Graphics & Design	3	3	0	0	3
	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
	U18ESAE301	ES	Fundamentals of Fluid Mechanics	3	3	0	0	3
	U18ESAE302	ES	Fundamentals of Aero – Thermodynamics	3	3	0	0	3
	U18ESAE303	ES	Fundamentals of Structural Mechanics	3	3	0	0	3
PRACTICAL								
	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	4	0	0	4	2
	U18ESME1L2	ES	Workshop / Manufacturing Practices Laboratory	3	3	0	0	3
	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Laboratory	4	0	0	4	2
	U18ESAE3L1	ES	Fluid Mechanics and Machinery Laboratory	4	0	0	4	2
TOTAL				**33**	21	0	12	27

LIST OF COURSES UNDER PROFESSIONAL CORE COURSES (PC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
	U18PCAE301	PC	Fundamentals of Aeronautics and Astronautics	2	2	0	0	2
	U18PCAE302	PC	Fundamentals of Mechanics and Machines	3	3	0	0	3
	U18PCAE401	PC	Elements of Aerospace Structures	3	3	0	0	3
	U18PCAE402	PC	Low Speed Aerodynamics	3	3	0	0	3
	U18PCAE403	PC	Aircraft Propulsion	3	3	0	0	3
	U18PCAE404	PC	Aircraft Systems and Instrumentation	2	2	0	0	2
	U18PCAE405	PC	Manufacturing Technology	2	3	0	0	3
	U18PCAE501	PC	Aircraft Structural Mechanics	3	3	0	0	3

	U18PCAE502	PC	Gas Dynamics	3	3	0	0	3
	U18PCAE503	PC	Advanced Aerospace Propulsion	3	3	0	0	3
	U18PCAE504	PC	Aircraft Performance	3	3	0	0	3
	U18PCAE505	PC	Control Systems	3	3	1	0	4
	U18PCAE601	PC	Finite Element Analysis	3	3	0	0	3
	U18PCAE602	PC	Aircraft Stability and Control	3	3	0	0	3
	U18PCAE701	PC	Computational Fluid Dynamics for Aerospace Engineering	3	3	0	0	3
	U18PCAE702	PC	Introduction to Avionics	3	3	0	0	3
PRACTICAL								
	U18PCAE3L1	PC	Strength of Materials Laboratory	4	0	0	4	2
	U18PCAE3L2	PC	Computer Aided Design and Drafting Laboratory	4	0	0	4	2
	U18PCAE4L1	PC	Aerodynamics Laboratory	4	0	0	4	2
	U18PCAE4L2	PC	Manufacturing Technology Laboratory	4	0	0	4	2
	U18PCAE4L3	PC	Aero Design and Modeling Laboratory	4	0	0	4	2
	U18PCAE5L1	PC	Aircraft Structures Laboratory	4	0	0	4	2
	U18PCAE5L2	PC	Aircraft Maintenance Laboratory	4	0	0	4	2
	U18PCAE5L3	PC	Flight Simulation Laboratory	4	0	0	4	2
	U18PCAS5L4	PC	Simulation tool for Aerospace Applications	4	0	0	4	2
	U18PCAE6L1	PC	Computer Aided Analysis Laboratory	4	0	0	4	2
	U18PCAE6L2	PC	Propulsion Laboratory	4	0	0	4	2
	U18PCAE7L1	PC	Avionics Laboratory	4	0	0	4	2
TOTAL				93	45	01	48	71

LIST OF COURSES UNDER Employability Enhancement (EE) Courses such as Project Work, Technical Seminar, Internship, Term Paper etc.,

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18EEAE6L1	EE	Aircraft Design Project – I	4	0	0	4	2
2	U18EEAE7L1	EE	Aircraft Design Project – II	4	0	0	4	2
3	U18EEAE8C1	EE	Comprehension	0	0	0	2	1
Total				8	0	0	10	5

LIST OF COURSES UNDER (PR) Project Work

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PRAE7P1	PR	Project Phase I	4	3	0	0	3
2	U18PRAE8P2	PR	Project Phase II	18	0	0	18	9
Total				22	3	0	18	12

LIST OF COURSES UNDER MANDATORY COURSES (MC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
	U18MCTH401	MC	Constitution of India	2	2	0	0	0
	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
	U18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
	18MCAB203	MC	Yoga	2	0	0	2	0
	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
	U18MCAB713	MC	Behavioral and	2	0	0	2	0

			Interpersonal Skills					
	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
	U18MCAB818	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL				36	6	0	36	0

Subject code: U18HSEN101	**Subject Name : COMMUNICATIVE ENGLISH (Common to B. Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – School Level English				
	Course Coordinator Name & Department:- Mr. M. Gopinath & Dept. of English				
COURSE OBJECTIVES:-	Enhance the learner's communication skills by giving adequate exposure in LSRW – Listening, Speaking, Reading, Writing skills and the related sub-skills. Help the learners recognize and operate in various styles and registers in English.				

UNIT I SPEAKING

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations introducing oneself – exchanging personal information- narratingevents, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development – prefixes- suffixes - articles, prepositions.

UNIT II READING

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun pronoun agreement

UNIT IV WRITING Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Pre

UNIT V LANGUAGE DEVELOPMENT Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-listening to talks, conversations to complete the remaining, participating in conversations-short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence-Organizing principles of paragraphs in documents- Techniques for writing precisely

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES (COs)	
CO1	Enable students to learn and identify faulty pronunciation, grammar and vocabulary. (Understand)
CO2	Help students develop the knowledge, skills and strategies to become proficient and independent readers and make them to interact and construct meaning from the content.(Analyze)
CO3	Develop listening abilities of the students, and teach basic listening strategies and expose them to a number of different listening situations through activities. (Remember)
CO4	Impart writing skills by sensitizing the learners to the dynamics of effective writing. (Create)
CO5	Recognize culture-specific perspectives and values embedded in language behavior to make students interpret authentic texts of different genres. (Analyze)
CO6	Communicate effectively using verbal and non-verbal communication skills. (Apply)

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1		H										M
	CO2			M							M		
	CO3				H							H	
	CO4					H		M					
	CO5						H		H	L			
	CO6												
3	Category	Basic Sciences (BS)											
4	Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSMA101	**Engineering Mathematics – I (Common to B. Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite Course– School Level Mathematics				
	Course Coordinator Name & Department – Ms. J. Aiswarya& Department of Mathematics				
COURSE OBJECTIVES	➢ The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. ➢ It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3) Hrs

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3) Hrs

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3) Hrs

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3) Hrs

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3) Hrs

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXTBOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.

3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition
Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	Analyze the optimum solution of various engineering problems involving single variables.
CO2	Know the basic concepts of integration and evaluating the problems which involves Beta and Gamma functions.
CO3	Solve the differential functions and optimizes the problems with two variables functions.
CO4	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three-dimensional spaces.
CO5	Evaluate Eigenvalue and eigen vector problems from practical areas using transformations;
CO6	Construct the eigen vector for the problem in engineering field and Diagonalizing the matrix

Mapping of Course Outcomes with Program outcomes (POs) **H –High, M-Medium, L-Low**													
1	**COs/Pos**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	**CO1**	H	H										L
	CO2	H	H			M							M
	CO3	H	H	M		M							M
	CO4	H	H			M							M
	CO5	H	H	M									L
	CO6	H	H										L
3	**Category**	Basic Science (BS)											
4	**Approval**	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	WAVES AND OPTICS (For B.Tech –Common to all branches)	L	T	P	C
	Total contact hours -45	3	0	0	3
	Prerequisite: +2				
	Course offered by –Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity. **(Contact Hours - 9)**

UNIT 2 ULTRASONIC WAVES

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.**(Contact Hours - 9)**

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.**(Contact Hours - 9)**

UNIT 4 WAVE OPTICS

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power.**(Contact Hours - 9)**

UNIT 5 LASERS

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.**(Contact Hours - 9)**

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org
9)

COURSE OUTCOMES(COs)	
CO1	Describe the basic concept of waves (Understand)
CO2	Identify the importance of Ultrasonic waves (Understand)
CO3	Recognizethe propagation of light and geometrical optics (Remember)
CO4	Discuss the optical phenomenon like interference, diffraction and superposition of waves (Understand)
CO5	Observe the concept of laser and its applications (Understand)
CO6	Examine the properties of light and sound waves and its wide range of applications(Apply)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	M										
	CO2	H	M	H									
	CO3	H	M										
	CO4	H	M	L									
	CO5	H	M	H									
	CO6	H	M	H									
3	Category	**Basics Sciences(BS)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	Subject Name: ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course: +2				
	Course Offered by : Dept.of.Chemistry				
	Data Book/ Codes/ Standards : Periodic Table				

UNIT I WATER TECHNOLOGY (Contact Hours – 09)

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS (Contact Hours – 09)

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead. Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non-ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES (Contact Hours – 09)

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS (Contact Hours – 09)

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY (Contact Hours – 09)

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires:

Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	Discuss boiler feed water requirements and water treatment techniques **(Understand)**
CO2	Explain the industrial importance of Phase rule and its applications to one and two component systems **(Apply)**
CO3	Illustrate the principles of Conventional and non- conventional energy sources and energy storage devices **(Understand)**
CO4	Describe the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels **(Remember)**
CO5	Classify Nanomaterials and state their applications in biology and medicine**(Understand)**
CO6	Describe the industrial requirements for resources, energy and materials administer **(Apply)**

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	**H**			**M**		**H**		**H**				
	CO2		**L**	**H**		**M**		**H**		**M**	**H**		
	CO3		**M**		**H**		**L**						
	CO4	**H**		**M**	**L**			**M**					
	CO5		**H**		**L**		**M**				**M**		
	CO6	**M**									**H**		
3	**Category**	Basic Sciences (BS)											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Computer Science and Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition , Updated for Python3, Shroff/O'Reilly Publishers, 2016
2. (http://greenteapress.com/wp/think-python/)
3. Guido van Rossum and Fred L. Drake Jr,— An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013

2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Understand basic of algorithmic solutions to find simple computational problems.
CO2	Execute basic syntax, data expressions and programs in Python.
CO3	Apply conditional statements and functional parameters to read and write input/output files
CO4	Analyze list operations, tuples assignments, various dictionaries and sorting methods.
CO5	Remember user-defined functions, modules and packages.
CO6	Implement the exception and file handling operations using various list parameters.

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	L										
	CO2	H	M										
	CO3	M	M	M									
	CO4	H	H	H	L	L							
	CO5	H		M		M							
		M	M										
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – Higher Secondary School Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet des needs, using the techniques, skills, and modern engineering tools necessary engineering practice				

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP;

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4: SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True

shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.
CO6	Crete 3D part models. Develop its surfaces with solid modelling software for assembly of parts

Mapping of Course Outcomes with Student Outcomes (SOs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M			H					
	CO2	H	H	L		H	M						
	CO3			H									
	CO4											H	
	CO5	H						L					
	CO6	M		H		H					H		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSPH2L1	WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech. –Civil, Mech, Mechatronics, Aero, Aerospace & Auto)	L	T	P	C
	Total contact hours - 30	0	0	4	2
	Prerequisite: Wave Optics and Mechanics				
	Course offered by – Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

PHYSICS LAB EXPERIMENTS FOR SEMESTER I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

COURSE OUTCOMES(COs)	
CO1	Achieve the fundamental concept of optics (Precision)
CO2	Demonstrate the concept of production of ultrasonic waves (Manipulate)
CO3	Achieve the basic concept of mechanics (Precision)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H	H						H		
	CO2	H		H									
	CO3	H		M	H						H		
3	Category	**Basics Sciences(BS)**											

4	**Approval**	47th Meeting of Academic Council held in Aug, 2018

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Estimate certain properties of water, Standardize solutions using titration, Conductivity meter, pH-meter **(Understand)**
CO2	Recognize basic principle of spectrophotometric method **(Remember)**
CO3	Analyze some important physical properties like viscosity and rate of Corrosion of the samples **(Analyze)**

Mapping of Course Outcomes (COs) with Progrmme Outcomes (POs)

(H/M/L indicates strength of correlation) : H – High, M – Medium, L – Low

COs/POs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H									
CO2	M			M	H							
CO3	H	H	H			H	H	M				

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESCS1L1	PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)

3. ExSOnentiation (SOwer of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib
CO6	To Understand about Simulate bouncing ball using Pygame.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO 11	PO 12
2	CO1	M		M		M				M			
	CO2	M		M	H	M				M			
	CO3	M		M	H	M				M			
	CO4	M		M		M				M			

	CO5	M		M		M				M			
	CO6	M		M	H	M				M			
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18HSEN201	**TECHNICAL ENGLISH**	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite course –1 Semester English				
	Course Coordinator Name & Department:- Mr. M. Gopinath& Dept. of				
OBJECTIVES	➢ Train the students in technical writing in English in writing descriptions of gadgets, Preparing texts and reports as well as comprehending technical texts. Prepare the students in content writing and copy editing				

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issuebased essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependent, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	Develop global listening abilities of the students, and teach them a few basic listening strategies and expose them to a number of different listening situations through activities. (Understand)
CO2	Help students develop the knowledge, skills and strategies they must possess to become proficient and independent readers who is able to interact and construct meaning from the content. (Apply)
CO3	Use technical information and knowledge in practical documents for a variety of professional audiences, including peers and colleagues or management, and public audiences.(Apply)
CO4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Create)
CO5	Help students recognize culture-specific perspectives and values embedded in language behavior. Decode, analyze, and interpret authentic texts of different genres. (Evaluate)
CO6	Designing digital slides. Breaking up a presentation into parts of reasonable length. Using statistics effectively to persuade an audience. Incorporating concrete examples and stories to illustrate points. (Create)

COs \POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										H
CO2			H							M		
CO3				H							H	
CO4					M		H					
CO5						M		M	L			
CO6												

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of the Academic Council

U18BSMA201	**Engineering Mathematics II (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	**3**	**1**	**0**	**4**
	Prerequisite Course– School Level Mathematics				
	Course Coordinator Name & Department – Dr. N. Ramya& Department of Mathematics				
COURSE OBJECTIVE	➢ The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables. ➢ Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.
5.

COURSE OUTCOMES (COs)	
CO1	Solve the higher order differential equations with constant and variable coefficients.
CO2	Apply Green's, Stoke's and Gauss Theorems in the application of engineering problems which involves line, surface and volume integrals .
CO3	Understand the analytic functions and able to construct an analytic function, solve the conformal mapping
CO4	Evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	Apply the concept of Laplace Transformation in analysis.
CO6	Use Laplace transform methods to solve differential equations.

Mapping of Course Outcomes with Program outcomes(POs)
H –High, M-Medium, L-Low

1	**COs/POs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	**CO1**	H	H			M							L
	CO2	H	H	L		L							M
	CO3	H	H	M		M							M
	CO4	H	H	M		L							H
	CO5	H	H	M									H
	CO6	H	H										H
3	**Category**	Basic Science (BS)											
4	**Approval**	47th Academic Council Meeting held in Aug, 2018											

U18BSPH201	**INTRODUCTION TO MECHANICS (Common to B.Tech. –Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	**L**	**T**	**P**	**C**
	Total contact hours -45	3	0	0	3
	Prerequisite: +2				
	Course offered by –Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

UNIT I -Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates**(Contact Hours – 9)**

UNIT II - Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits. **(Contact Hours – 9)**

UNIT III - Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance**(Contact Hours – 9)**

UNIT IV - Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body**(Contact Hours – 9)**

UNIT V - Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with centre of mass fixed. **(Contact Hours – 9)**

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.
2. M.K. Harbola, "Engineering Mechanics", 2nd edition, Cengage, 2013.
3. M.K. Verma, "Introduction to Mechanics", 1st edition, CRC press, 2009.

4. D.Kleppner&RKolenkow, “An Introduction to Mechanics”, McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, “Engineering Mechanics – DynamicsVol 2”, 7th ed. Wiley, 2012
6. JP Den Hartog, “Mechanical Vibrations”, Dover Publications, Inc., 1985
7. WT Thomson, “Theory of Vibrations with Applications”, Pearson, 5th edition, 1997.

Online References: Wikipedia org

COURSE OUTCOMES(COs)	
CO1	Identify and solve the various equation of motions in different coordinate systems (Remember)
CO2	Generalize the idea of conservation of energy and angular momentum (Understand)
CO3	Visualize the concept of harmonic motion in different damped conditions (Remember)
CO4	Discuss the motion of a rigid body under different criteria (Understand)
CO5	Describes the motion of a rigid body in three dimensions (Understand)
CO6	Demonstrates the basics of particle motion and kinematics in 1D, 2D and 3D (Apply)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	M										
	CO2	H											
	CO3	H	M										
	CO4	H	H	M	H								
	CO5	H	H	M	H	H					H		H
	CO6	H			M						H		
3	Category	**Basics Sciences(BS)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	ENVIRONMENTAL SCIENCES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course +2				
	Course Offered by Dept of Chemistry				
OBJECTIVES	➢ To study the interrelationship between living organism and environment. ➢ To study of the nature and concepts of ecosystem. ➢ To learn about the integrated themes and biodiversity of an environment. ➢ To study of pollution control and waste management. ➢ To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Observe the overutilization of water and energy from different sources, conserve water and identify alternative energy sources **(Remember)**
CO2	Explain different ecosystem, identify possible solutions to environment issues
CO3	Describe the biodiversity, its importance and conservation **(Remember)**
CO4	Explain various forms of environment pollution and realize the responsibilities of individuals in prevention of pollution **(Apply)**
CO5	Identify the social and environmental issues and predict the possible engineering solutions **(Understand)**
CO6	Describe the social and environmental problems and administer the possible solutions **(Apply)**

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M								
	CO2	M	H	H		M							L
	CO3		M										
	CO4	H		M	L								M
	CO5		H		L						H		

	CO6										**H**		
3	Category	Humanities and Social Sciences (HS)											
4	Approval	47th Meeting of Academic Council											

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector					

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System - types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3.

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)													
CO1	Recall the relationship between structure and function of cells at molecular level												
CO2	List the defining characteristics of biological life												
CO3	Determine the importance of genetics and immunological response												
CO4	Categorize the mechanism of infection about diseases and disorders affecting specific organs												
CO5	Demonstrate the techniques from multiple disciplines and apply to biological problems												
CO6	Discuss the biological science related to different disciplinary areas.												
Mapping of Course Outcomes with StudentsOutcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	L											L
	CO2	L											
	CO3	M											
	CO4	L											
	CO5	H					L						L
	CO6	M											L
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE101	**Basic Electrical and Electronics Engineering**	**L**	**T**	**P**	**C**
	Total contact hours-45	**3**	**0**	**0**	**3**
	Prerequisite: School Level Physics				
	Course offered by –Department of Electrical and Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications.				

MODULE 1 :DCCIRCUITS (12 periods)

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2:AC CIRCUITS (9 Periods)

Representationofsinusoidalwaveforms,peakandrmsvalues,phasorrepresentation,realpower, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and deltaconnections.

MODULE 3: ELECTRICAL MACHINES&TRANSFORMERS (9 Periods)

Principles of operation and characteristics of; DC machines, Synchronous machines, threephase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer.

MODULE 4: SEMICONDUCTOR DEVICESANDAPPLICATIONS (9 periods)

CharacteristicsofPNJunctionDiode–ZenerEffect–ZenerDiodeanditsCharacteristics–Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction toOP-AMP.

MODULE 5:DIGITALELECTRONICS (6 Periods)

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird,, Electrical Circuit Theory &Technology,Taylor & Francis Ltd, 6th, edition.2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning,2007.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press,2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition,2011.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition,2015.

6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition,2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers,2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Higher Ed, 1st Edition,2011.
3. Jacob Millman and Christos C-Halkias,“Electronic Devices and Circuits”, McGraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES(COs)	
CO1	Apply simple electrical circuits and verify DC network theorems.**(Apply)**
CO2	Obtain electrical parameters like voltage, current, power and sketch phase diagram of a given ac circuits. .**(Understand)**
CO3	Explain the working principle of DC, AC Machines and transformer.**(Understand)**
CO4	Draw the characteristics of semiconductor devices and to obtain signal analysis of BJT **(Understand)**
CO5	Perform the basic Boolean operations. **(Remember)**

Mapping of course outcomes with programme outcomes(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	L	L	-	-	-	-	-	-	-	-
	CO2	H	M	L	L	-	-	-	-	-	-	-	-
	CO3	H	L	-	-	-	-	-	-	-	-	-	-
	CO4	H	-	L	L	-	-	-	-	-	-	-	-
	CO5	H	M	M	L	-	-	-	-	-	-	-	-
3	Category	**Engineering Science(ES)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18ESME1L2	**Workshop/Manufacturing Practices Laboratory**	L	T	P	C
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

Lectures & videos: (15 hours)

1. Detailed contents
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lecture)
3. CNC machining, Additive manufacturing (2 lecture)
4. Fitting operations & power tools (2 lecture)
5. Carpentry (2 lecture)
6. Plastic moulding, glass cutting (2 lecture)
7. Metal casting (2 lecture)
8. Welding (arc welding & gas welding), brazing (2 lecture)

WORKSHOP PRACTICE:

Machine shop (6 hours)

1. Facing
2. Turning
3. Drilling Practice

Fitting shop (6 hours)

1. Fitting Exercises–Preparation of square fitting
2. Vee–fittingmodels.

Carpentry (9 hours)

a) Preparation of Lap joints.
b) Mortise and Tenonjoints.
c) Cross Half joints.
d) Dove Tail joints.

Welding shop (Arc welding 6 hrs + gas welding 3 hrs) (9 hours)

Preparation of butt joints, lap joints and Tee joints

Sheet Metal working (9 hours)

Forming &Bending:
Model making–Trays, funnels, etc.
Different type of joints

Demonstration (6 Hours)

Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of

Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1											S	
	CO2			S	M								
	CO3		M									S	
	CO4	S			W							S	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE1L3	BASIC ELECTRICAL AND ELECTRONIC ENGINEERING PRACTICES LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and CurrentLaws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a stepchangeinvoltage(transientmaybeobservedonastorageoscilloscope).Sinusoidalsteadystate response of R-L, and R-C circuits – impedance calculation andverification.
3. Fluorescent lampwiring.
4. Staircasewiring.
5. Measurement of energy using single phase energymeter.
6. Observationoftheno-loadcurrentwaveformonanoscilloscopeandMeasurementofPrimary and secondary voltages and currents of aTransformer.
7. Demonstration of cut-out sections of machines: dc machine (commutator-brusharrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase inductionmachine.
8. Demonstrationof(a)dc-dcconverters(b)dc-acconverters–PWMwaveform(c)theuseofdc-acconverter for speed control of an induction motor and (d) Components of LTswitchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and functiongenerator.
2. Characteristics – Half wave and Full waveRectifiers.
3. Characteristics – Common Base transistorconfiguration.
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK andRS.
5. Applications of OperationalAmplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES(COs)													
CO1	Implementation of circuits for verification of basic laws and theorems**(Imitation)**												
CO2	Perform the different types of residential wiring and to measure the electrical quantities like voltage ,current and power.**(Manipulation)**												
CO3	Draw the characteristics of semiconductor devices**(Imitation)**												
Mapping of course outcomes with programme outcomes(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	L	L	M	H	L	-	-	-	M	-	-	-
	CO2	L	L	M	H	L	-	-	-	M	-	-	-
	CO3	L	L	M	H	L	-	-	-	M	-	-	-
3	Category	**Engineering Science(ES)**											
4	**Approval**	47th Meeting of Academic Council, May 2018											

SEMESTER III

	Partial Differential Equations, Probability and Statistics (Common to B. Tech – Mech, Mechatronics, Automobile and Aero Engineering admitted from July 2018)	**L**	**T**	**P**	**C**
U18BSMA302	Total Contact Hours -60	**3**	**1**	**0**	**4**
	Prerequisite Course– Engineering Mathematics I & II				
	Course Coordinator Name & Department – K.L. Rajashree& Department of Mathematics				

OBJECTIVE:

- Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.
- Learn techniques of solving the standard types of first order and second order partial differential equations.
- Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem.
- Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases. Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT IV PROBABILITY DISTRIBUTION 12

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS 12

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXTBOOKS:

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993. [Units I to V].

2. S.C.Gupta&V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2003. [Units I to III].

REFERENCES:

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. “Applied Statistics and Probability for Engineers”, 6th Edition. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. “Quality and Reliability in Engineering”. Book Vistas, New Delhi.

WEBLINKS:

https://nptel.ac.in/courses/111105093/
https://onlinecourses.nptel.ac.in/noc18_ma12/preview

	COURSE OUTCOMES (COs)
CO1	Apply Fourier series method to engineering problems. (Apply)
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results. (Apply)
CO3	Analyze the solutions ofone dimensional and two dimensional boundary value problems in partial differential equations.(Analyze)
CO4	Apply the concept of probability to various distributions in engineering problems. (Apply)
CO5	Evaluate thestatistical problems including measures of central tendency, correlation and regression. (Evaluate)
CO6	Analyse the testing of hypothesis to statistical data. (Analyze)

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3 –High, 2-Medium,1-Low

1	**COs/POs**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
2	**CO1**	H	H	L		L							L			
	CO2	H	H	L		M							M			
	CO3	H	H	M		L							M			
	CO4	H	H	M	L	L							L			
	CO5	H	H	L	M	M							M			
	CO6	H	H		M	M							M			
3	**Category**	Basic Science (BS)														
4	**Approval**	47th Academic Council Meeting held in Aug 2018														

U18PCAE301	**FUNDAMENTALS OF AERONAUTICS AND ASTRONAUTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**2**	**0**	**0**	**2**
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To help the student understand the history of aviation, different kinds of aircrafts, spacecrafts, their components and functioning.					

UNIT I EVOLUTION OF FLIGHT 4

Brief history of Aviation-Hot air balloon and heavier than air flying machines-early airplane configurations-Modern Airplanes-Components of airplane and their functions-Rotary wing aircrafts-Space vehicles.

UNIT II FUNDAMENTALS OF AERODYNAMICS 10

International Standard Atmosphere-Pressure, Temperature and Density altitude, Bernoulli's equation-Mach number-subsonic, transonic, sonic and supersonic flow regimes, Measurement of pressure and airspeed- IAS,EAS and TAS. Airfoil geometry and nomenclature - airfoil characteristics - lift, drag and moment coefficients-angle of attack-aspect ratio- induced drag and parasite drag.

UNIT III AIRCRAFT STRUCTURES AND MATERIALS 4

Structural components of an airplane- monocoque and semi monocoque structure –materials for structural components – composite materials and their significance in Aviation Technology.

UNIT IV AIRCRAFT PROPULSION 8

Propeller Engine – Gas Turbine Engine – Turbo prop, Turbo jet, Turbo fan Engines - variation of thrust, powerand specific fuel consumption with speed and altitude – materials for engine components.

UNIT V SPACE VEHICLES AND ASTRONAUTICS 4

Basics of Rocket Technology – escape velocity – re-entry vehicles – Satellite technology– Hypersonic vehicles, Elements of Astronautics.

TEXTBOOKS:

1. Anderson, J. D., Introduction to Flight, Tata-McGraw-Hill Higher Education, 6th edition 2010.

REFERENCES:

1. Kermode, A. C, Barnard, R. H and Philpott, D. R, Mechanics of Flight, Pearson education, 2012.
2. Shevell, R. C., Fundamentals of Flight., Prentice hall (2nd edition), 1989.
3. Steven, A. Brandt, Randall J. Stiles, John J. Bertin and Ray Whitford, Introduction to Aeronautics: A Design Perspective, AIAA Education series (2nd edition),2004.
4. Torenbeek, E and Wittenberg, H, Flight Physics:Essentials of Aeronautical Disciplines and Technology, with Historical Notes, Springer, 2009.

WEBLINKS:

https://www.edx.org/course/introduction-to-aeronautical-engineering

COURSE OUTCOMES	
CO 1	**Describe** the basic components of airplane and various flight vehicles. (**Remember**)
CO2	**Summarize** the variation of aircraft performance at various altitudes. (**Understand**)
CO3	**Explain** the structural components of airplane and materials used for aircraft construction. (**Understand**)
CO4	**Describe** the working of different types of aircraft engines and their performances. (**Understand**)
CO5	**Discuss** the theory behind rocket propulsion and the problems associated with hypersonic vehicle operation. **(Understand)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	H									M			H	M	M
CO2	H				M								H		
CO3	H									M		H			M
CO4	H											H		M	
CO5	H											H		M	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE302	FUNDAMENTALS OF MECHANICS AND MACHINES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Introduction to Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enable the student to understand about the basics of mechanics, working of machines, the forces acting on different machines and the corresponding motion, prediction and design of machines.

UNIT I EQUILIBRIUM OF RIGID BODIES 9

Free Body Diagram, Equilibrium of Forces and Moments, Lame's theorem, Parallelogram and Triangle Law of Forces, Force Resolution, Types of Supports and Reactions, Requirements of Stable Equilibrium, Moments and Couple – Moment of force about a point and about an axis, Vector operation of forces, Resolution of Forces, Resultant of Several Concurrent Forces, Forces in Space

UNIT II PROPERTIES OF SURFACES AND SOLIDS 8

Determination of Areas, First Moment of Area and the Centroid of Standard Sections – T Section, I Section, Composite Figures, Hollow Section – Second Moments of Plane Area (Rectangle, Triangle, Circle, T Section, I Section, Hollow Section), Parallel Axis Theorem, Perpendicular Axis Theorem, Polar Moment of Inertia, Principal Moments of Inertia of Plane Areas – Basic Concepts of Mass Moment of Inertia

UNIT III MECHANISMS 10

Machine and Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom –Kutzbach criterion - Slider crank and crank rocker mechanisms – Inversions – Applications –Kinematic analysis of simple mechanisms – Determination of velocity and acceleration. – Introduction to Gears and Cams

UNIT IV FRICTION 8

Frictional force, Laws of Coulomb Friction, Cone of Friction, Angle of Repose, Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (Flat and Vee) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT V FORCE ANALYSIS AND BALANCING 10

Introduction to force analysis – Inertia force and inertia torque - Static and dynamic balancing Single and several masses in different planes –Balancing of reciprocating masses-primary balancing and concepts of secondary balancing – Single and multicylinder engines

TEXTBOOKS:

1. F. P. Beer, E.R. Johnston, and J.T. Dewolf, Mechanics of Materials, McGraw-Hill (4th edition), 2006 (Unit 1 & 2)
2. Rattan.S.S., Theory of Machines, Tata McGraw–Hill Publishing Co, New Delhi, 2004. (Unit 3 to 5)

REFERENCES:

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.

2. Malhotra, D.R and Gupta, H.C., “The Theory of Machines”, Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, Affiliated East West Press,1989.
4. Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw-Hill, 1980.
5. Burton Paul, “Kinematics and Dynamic of Planer Machinery”, Prentice Hall, 1979.
6. Balaguru. S., Dynamics of Machinery, SciTech publication (2nd edition), 2009.

WEBLINKS:

www.simplemachines.org/
ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5593596
https://onlinecourses.nptel.ac.in/noc19_me29/preview

	COURSE OUTCOMES
CO1	**Identify** the forces and its magnitude. **(Remember)**
CO2	**Discuss** the moment under area consideration with C.G Locations. **(Understand)**
CO3	**Describe** the working of different mechanisms along with inversion and their corresponding velocity and acceleration diagrams. (**Apply**)
CO4	**Determine** the Power transmission in machine elements using fundamentals of friction. (**Apply**)
CO5	**Determine** the unbalanced forces acting on rotating and reciprocating parts in engine. **(Apply)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	H				H										H
CO2	H														H
CO3	H				H					H					H
CO4	H				H					H					H
CO5	H														H

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18ESAE301	FUNDAMENTALS OF FLUID MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Introduction to Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To help the student understand the basic physics of fluids, fluid behavior under different conditions, laws governing fluid flows, measurements in fluids and functioning of fluid machinery.

UNIT I INTRODUCTION 7

Fluid –definition-Fluid properties-Newton's law of viscosity-Classification of fluids-fluid statics-Hydrostatic forces on submerged surfaces- basics of Stability of floating bodies

UNIT II FLUID FLOW ANALYSIS AND FLOW MEASUREMENT 10

Ideal and real flow-Concept of continuum-Eulerian and Lagrangian approaches-Velocity field-Pathline, Streakline, Streamline- Stream tube- Fluid acceleration-Continuity, momentum differential equations-Navier Stokes equation-Bernoulli's equation and its applications-Venturimeter-Orifice meter, Coefficient of Discharge, Flow Rate and Velocity Measurement.

UNIT III DIMENSIONAL ANALYSIS 8

Dimensional Homogeneity, Buckingham's Pi Theorem-Non dimensional numbers and their significance-Flow similarity, similitude, incomplete similarity and model studies – distorted models

UNIT IV FLOW THROUGH PIPES 11

Laminar and turbulent flow- Boundary layer flow – Boundary layer thickness - Reynolds number and its significance-Laminar fully developed pipe flow-Hagen-Poiseuille flow-Coefficient of friction-Head loss – Darcy-Weisbach equation-Hydraulic gradient- Total energy lines-Moody's diagram

UNIT V FLUID MACHINERY 9

Classification of fluid machines-Reciprocating and centrifugal pumps-impulse and reaction turbines and velocity triangles-Working principle of Pelton, Francis and Kaplan turbines

TEXTBOOKS:

1. Rathakrishnan. E, Fundamentals of Fluid Mechanics, Prentice-Hall (3rd edition), 2012.

REFERENCES:

1. Bansal. R. K., "A textbook of Fluid Mechanics", Laxmi Publications, 2008
2. Frank M White, Fluid Mechanics, The McGraw Hill companies. (7th edition), 2011.
3. Yunus A Cengel and John M Cimbala, Fluid mechanics: Fundamentals and Applications, Tata McGraw Hill (2nd edition), 2010.
4. Irving H Shames, Mechanics of Fluids, The McGraw Hill companies (4th edition), 2003.
5. Yuan, S.W, Foundations of Fluid Mechanics, Prentice-Hall, 1967.

WEBLINKS:

reu.eng.ua.edu › Programs
www.fluidmechanics.co.uk/
https://onlinecourses.nptel.ac.in/noc17_me04/course

COURSE OUTCOMES

CO1	**Recall** the concepts of fluids, properties of fluids and its classification. (**Remember**)
CO2	**Calculate** the flow properties using the fundamental equations of fluid motion. (**Apply**)
CO3	**Solve** problems based on dimensional analysis and fluid flow analysis. (**Apply**)
CO4	**Examine t**he pipe line system for minimum head loss. (**Apply**)
CO5	**Calculate** the performance and operating characteristics of turbines and pumps. **(Apply)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COS/ POS	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	PSO1	**PSO2**	**PSO3**
CO1	H												H		
CO2	H												H		
CO3	H											L	H		
CO4	H									H			H		
CO5	H									H			H		
Category	**Engineering Science (ES)**														
Approval	**48th Academic Council Meeting**														

	FUNDAMENTALS OF AERO – THERMODYNAMICS	L	T	P	C
U18ESAE302	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the student understand about the basics of engineering thermodynamics, various laws and their applications, prediction of thermodynamic performance of various engines, and other thermal devices.					

UNIT I BASIC CONCEPTS AND FIRST LAW 7

Continuum, microscopic and macroscopic approach, thermodynamic system and surrounding, state, path, process, heat and work, zeroth law, concept of ideal and real gases, internal energy, specific heat capacities, enthalpy, first law of thermodynamics – PMM-1

UNIT II FIRST LAW APPLIED TO FLOW PROCESSES 10

Control volume – steady flow processes – steady flow energy equation – mass and energy balance – example of steady flow processes – variable flow processes

UNIT III SECOND LAW AND ENTROPY 11

Second law of thermodynamics, Kelvin – Planck's and Clausius Statements, PMM-2, reversibility and irreversibility, Carnot theorem, refrigerator, heat engine and heat pump, concept of entropy, irreversibility, Clausius inequality, principle of increase in entropy, absolute entropy, entropy generation in open and closed systems, entropy change in non-flow processes, availability, exergy

UNIT IV AIR POWER CYCLES 9

Carnot, Otto, Diesel, Dual, Stirling and Ericsson cycle - Air standard efficiency – Mean effective pressure

UNIT V BRAYTON CYCLE 8

Introduction to aircraft propulsion – gas turbine engine cycles – open and closed Brayton cycle – Brayton cycle with reheat, regeneration and intercooling.

TEXTBOOKS:

1. Rathakrishnan E., Fundamentals of Engineering Thermodynamics, Prentice-Hall India, 2012.

REFERENCES:

1. Nag.P.K.,Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
2. Yunus A Cengel and Michael A Boles., Thermodynamics- an Engineering approach, McGraw Hill Education (7th edition), 2012.
3. Holman.J.P. Thermodynamics, McGraw-Hill (3rd edition), 2007.
4. Merle C Potter and Craig W Somerton., Thermodynamics for Engineers, Schaum's Outline Series, Tata McGraw-Hill (2nd edition), 2009.

WEBLINKS:

www.thermocalc.com/
www.grc.nasa.gov/WWW/cdtb/software/t-mats.html
https://www.edx.org/course/thermodynamics-2

COURSE OUTCOMES	
CO1	**Discuss** the fundamental laws of thermodynamics and its relations. **(Understand)**
CO2	**Solve** thermodynamic problems on first law of thermodynamics. **(Apply)**
CO3	**Solve** thermodynamic problems on Second law of thermodynamics. **(Apply)**
CO4	**Compute** the air standard efficiencies using P-V and T-S diagram of various air power cycles. (**Apply**)
CO5	**Calculate** the efficiency of jet propulsion cycles. (**Apply**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H												H	H	
CO2	H											H	H	H	
CO3	H									H		H	H	H	
CO4	H													H	
CO5	H									H				H	

Category	**Engineering Science (ES)**
Approval	**48th Academic Council Meeting**

	FUNDAMENTALS OF STRUCTURAL MECHANICS	L	T	P	C
U18ESAE303	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Introduction to Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To equip the students with the basics of structural mechanics and materials, material behavior & failure under load, its prediction and design based on it.					

UNIT I INTRODUCTION TO STRENGTH OF MATERIALS 10

Introduction to mechanics of deformable bodies - Material selection criteria – stress – strain – Stress and strain diagram - Hook's law - Elastic constants – definition of engineering constants: elastic moduli – Young's modulus, Bulk Modulus& Volumetric Strain, Poisson's ratio, Shear Modulus, relation between three elastic moduli and Poison's ratio, Statically determinate and indeterminate problems in tension and compression – Thermal stress – Impact loading – Composite bars

UNIT II STRESSES IN BEAMS 9

Shear force and bending moment diagrams for simply supported, cantilever beams and overhanging beams– bending stress variation in beams of symmetric sections, neutral axis

UNIT III DEFLECTION OF BEAMS 9

Double integration, Macaulay's method, moment area method, conjugate beam method, method of superposition, Maxwell's reciprocal theorem.

UNIT IV TORSION 8

Torsion of solid and hollow circular shafts – Power transmission in shafts – Open and closed-coiled helical springs – Stresses in helical springs.

UNIT V BI – AXIAL STRESSES AND ELEMENTS OF ELASTICITY 9

Stresses in thin cylindrical and spherical shell under internal pressure and volumetric strain– Principle stresses and maximum shear stresses– Combined loading – Mohr's circle and its construction – concept of theory of elasticity, basic assumptions, coordinate transformation, plane stress and plane strain conditions, stress tensor

TEXTBOOKS:

1. Gere & Timoshenko, Mechanics of Materials, McGraw Hill, 1993

REFERENCES:

1. F. P. Beer, E.R. Johnston, and J.T. Dewolf, Mechanics of Materials, McGraw-Hill (4th edition), 2006
2. Dym,C.L., and Shames,I.H., Solid Mechanics, McGraw Hill, Kogakusha, 1973.
3. Stephen Timoshenko, Strength of Materials, Vol I & II, CBS Publishers and Distributors, Third Edition.
4. R.K. Rajput, Strength of Materials, S. Chand and Co., 1999.
5. William Nash, Strength of Materials, Tata McGraw Hill, 2004
6. Timoshenko,S. and Young,D.H., Elements of Strength of Materials, T.VanNostrand Co. Inc., Princeton, N.J., 1977.

WEBLINKS:

www.mdsolids.com/
https://onlinecourses.nptel.ac.in/noc17_ce22/preview
https://www.actuspotentia.com/MechMat.shtml

COURSE OUTCOMES	
CO1	**Compute** the stress developed in statically determinate and indeterminate structures subjected to axial load. (**Apply**)
CO2	**Sketch** shear force and bending moment diagram for a given beam. (**Apply**)
CO3	**Determine** the deflection of beams using various methods (**Apply**)
CO4	**Compute** the shear stress developed in circular shafts and springs subjected to torsional and axial load. (**Apply**)
CO5	**Determine** principal stresses developed in structural components using Mohr'sCircle (**Apply**).

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PS O2	PS O3
CO1	H									H					H
CO2	H				M										H
CO3	H											M			H
CO4	H											M			H
CO5	H				M					H					H
Category	**Engineering Science (ES)**														
Approval	**48th Academic Council Meeting**														

U18PCAE3L1	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Strength Of Materials				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the students with hands on experience on conducting various structural tests to determine the structural properties of a given material.

LIST OF EXPERIMENTS

1 Tension test of a mild steel and aluminium rod.
2 Shear test on mild steel and aluminium rod.
3 Torsion test on mild steel rod.
4 Hardness test (a) Brinell& (b) Rockwell.
5 Impact tests (a) Izod& (b) Charpy.
6 Estimation of Stiffness of a Helical Spring (a) Open Coil & (b) Closed Coil
7 Fatigue test: Rotating beam.
8 Block compression test.
9 Flexural test by 3 point bending method
10 Determination of fracture strength and fracture pattern of ductile and brittle material.

REFERENCES:

1. Strength of Materials Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=D8U4G5kcpcM
https://www.youtube.com/watch?v=jpogdcw_Uh0

COURSE OUTCOMES	
CO 1	**Carry out** elementary mechanical coupon testing of materials as per the given procedure. **(Imitation)**
CO 2	**Acquire** data using the available measuring devices. **(Manipulation)**
CO 3	**Perform** basic mathematical calculation using the appropriate formulae and represent the results in form of graph and table **(Precision)**.

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

Cos / Pos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	H								H	H					H
CO 2	H								H	H					H
CO 3	H								H	H					H

Category	Professional Core (PC)
Approval	48th Academic Council Meeting

U18PCAE3L2	COMPUTER AIDED DESIGNING AND DRAFTING	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Engineering Graphics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with a practical experience of engineering drawing in the computer using commercial software packages.

LIST OF EXPERIMENTS

1 Study of various software for engineering design and drafting
2 Study of commercial software packages and their tools
3 Exercise on 2D drawing
4 Exercise on pad and groove
5 Exercise on shaft, mirror and array
6 Exercise on threading, bores and tappings
7 Exercise on part assembly
8 Exercise on drafting
9 Exercise on surface modeling
10 Exercise on kinematics

REFERENCES:

1. CADD Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://grabcad.com/tutorials

COURSE OUTCOMES	
CO 1	**Master** the geometrical profile and modification tools. **(Precision)**
CO 2	**Create** 3-Dimensional models from 2-Dimensional geometries. **(Naturalization)**
CO 3	**Design** basic Aerospace components using CADD. **(Articulation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	H	H							H	H			H	H	H
CO 2	H	H							H	H			H	H	H
CO 3	H	H							H	H			H	H	H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18ESAE3L1	**FLUID MECHANICS AND MACHINERIES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**4**	**2**
	Prerequisite – Fundamentals Of Fluid Mechanics				
	Course Designed by – Department of Civil Engineering				

OBJECTIVE: To equip the students with hands on experience on conducting various experimental tests to determine the fluid properties of a given fluid and also to assess the performance of various fluid machinery.

LIST OF EXPERIMENTS

1 Determination of pipe flow losses.
2 Calibration of orifice meter and venture meter.
3 Flow through notches and weir.
4 Flow through open orifice
5 Verification of Bernoulli's Equation.
6 Performance characteristics of centrifugal pump.
7 Performance characteristics of submergible pump.
8 Performance characteristics of jet pump.
9 Characteristics of impulse turbine – Pelton wheel turbine.
10 Characteristics of reaction turbine – Francis turbine

REFERENCES:

1. Fluid Mechanics and Machineries Lab Manual, Department of Civil Engineering, 2017

WEBLINKS:

https://www.arborsci.com/cool/fluid-mechanics/

COURSE OUTCOMES															
CO 1	**Observe** the flow characteristics in a pipeline system. **(Imitation)**														
CO 2	**Demonstrate** the Bernoulli's Equation. **(Manipulation)**														
CO 3	**Conduct** the Performance test of different Pumps and Turbines. **(Precision)**														
CO / PO MAPPING L –LOW, M – MEDIUM, H – HIGH															
Cos / Pos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	H								H	H			H		
CO 2	H								H	H			H		
CO 3	H								H	H			H		
Category	**Engineering Science (ES)**														
Approval	**48th Academic Council Meeting**														

SEMESTER IV

U18BSMA401	**Numerical Methods (Common to B. Tech - Mech, Mechatronics, Automobile, Aero admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours- 60	**3**	**1**	**0**	**4**
	Prerequisite Course – Engineering Mathematics I & II				
	Course Coordinator Name & Department– P. Bhathmanaban & Department of Mathematics				

OBJECTIVE:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT I SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 12

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT II INTERPOLATION 12

Finite differences - Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals- Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both 1/3rd and 3/8th rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods- Taylor series, Euler and modified Euler methods, Runge-Kutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's - Bash forth predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference - solution of 2nd order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for one dimensional wave equation.

TEXTBOOKS:

1. Sastry.SS "Introductory Numerical Methods" 5th edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.
3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005.

REFERENCES:

1. Curtis F. Gerald. "Applied Numerical Analysis", 7th Edition. Pearson Education,
2. Dennis G. Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edition. Jones & Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathi - Numerical methods, S.Chand& Company, 2nd Edition 2010.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_ma14/course

COURSE OUTCOMES (COs)	
CO1	Solve algebraic and transcendental equation using Newton Raphson and regula-Falsi methods and system of linear equations by various methods.
CO2	Apply method of interpolation and extrapolation for numerical data.
CO3	Describe the concept of numerical methods to differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Solve initial value problems of ODE by applying Taylor's series and runge-Kutta methods.
CO5	Analyse the two dimensional Laplace, Poisson equations and one dimensional heat and wave equations of PDE.
CO6	Develop one dimensional and two dimensional problems in engineering field.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3 –High, 2-Medium,1-Low

1	**COs/Pos**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
2	**CO1**	H	H			M							M		
	CO2	H	H	M									M		
	CO3	H	H	M									M		
	CO4	H	H			M							M		
	CO5	H	H										M		
	CO6	H	H	L		L							L		
3	**Category**	Basic Science (BS)													
4	**Approval**	47th Academic Council Meeting held in Aug 2018													

	ELEMENTS OF AEROSPACE STRUCTURES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
U18PCAE401	Prerequisite – Fundamentals of Mechanics and Machines, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the basics of aerospace structures, different types of structural members, their design and analysis.					

UNIT I TRUSSES AND FRAMES 9

Statically determinate frames - Analysis of plane Truss - Method of joints - 3 D Truss-Plane frames - Composite beam.

UNIT II STATICALLY INDETERMINATE BEAMS 9

Propped Cantilever - Fixed-Fixed beams - Clapeyron's Three Moment Equation – moment distribution method.

UNIT III ENERGY METHODS 11

Strain energy evaluation in structural members – Castigliano's Theorem – dummy load & unit load methods – Maxwell's reciprocal theorem – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses

UNIT IV COLUMNS 9

Euler's column curve – inelastic buckling – effect of initial curvature – the Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT V FAILURE THEORY 7

Fail safe and safe life structures, factor of safety, Brief introduction of yield material, brittle vs. ductile behavior, Creep and creep rupture, viscoelastic materials - environmental stress, stress potentials, effect of time and temperature - Fatigue and Fracture - Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.

TEXTBOOKS:

1. "Rajput, R. K.", "A Textbook of Strength of Materials", S Chand Publications, 2018 Edition

REFERENCES:

1. Timoshenko, S., Strength of Materials, Vol. I and II, Princeton D. Von NostrandCo, 1990.
2. Peery, D. J., and Azar J. J., Aircraft Structures, McGraw – Hill (2nd edition), 1999.
3. Bruhn.E.F., Analysis and design of flight vehicle structures,Tri set of offset company, 1973.
4. Michael C.Y.Niu,Airframe structural design (ISBN No.962-7128-04-X), 1998
5. Rivello,Theory and Analysis of Flight Structures, McGraw-Hill, 1969.

WEBLINKS:

https://online.stanford.edu/courses/aa240-analysis-aircraft-structures
https://www.edx.org/course/introduction-to-aerospace-structures-and-materials-0

COURSE OUTCOMES	
CO 1	**Determine** the forces acting in the members of statically determinate truss and frames. (**Apply**)
CO 2	**Calculate** the slope and deflection of statically indeterminate beams. (**Apply**)
CO 3	**Calculate** the deflection and strain energy ofstatically determinate and indeterminate structures. (**Apply**)
CO 4	**Compute** the buckling load and crippling stress of columns with different end conditions. (**Apply**)
CO 5	**Determine** the safe stress of the structural component using failure theories. (**Apply**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PS O1	PS O2	PS O3
CO 1	H									M					H
CO 2	H											M			H
CO 3	H									M		M			H
CO 4	H														H
CO 5	H														H

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18PCAE402	LOW SPEED AERODYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Mathematics I & II, Fundamentals of Fluid Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the students with the basic concepts necessary to understand the flow around low speed aircrafts, tools to estimate the forces thus generated and methods to design airfoils and wings of an aircraft.

UNIT I BASIC AERODYNAMIC PRINCIPLES 9

Models of fluid - System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity

UNIT II FUNDAMENTALS OF INVISCID FLOWS 9

Elementary Flows and their combinations – Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, KuttaJoukowski Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder

UNIT III AIRFOIL THEORY 9

Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

UNIT IV FINITE WING THEORY 9

Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations, induced drag coefficient, elliptic and general lift distribution, Oswald's wing efficiency factor, effect of plan form and aspect ratio

UNIT V VISCOUS FLOW THEORY 9

Laminar Boundary layer and its thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow

TEXTBOOKS:

1. Anderson, J.D., Fundamentals of Aerodynamics, McGraw Hill Book Co., 2006, Sixth Edition

REFERENCES:

1. Rathakrishnan,E., Theoretical Aerodynamics, John Wiley & Sons, Inc., 2013
2. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
3. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 5th Edition.
4. Clancy L J., Aerodynamics, John Wiley & sons, 1991.

WEBLINKS:

https://www.edx.org/course/introduction-to-aerodynamics

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005/

COURSE OUTCOMES	
CO 1	**Recall** the types of flows based on mathematical equations. (**Understand**)
CO 2	**Solve** flow over basic aerodynamic shapes using concept of inviscid flow theory.(**Apply**)
CO 3	**Determine** the geometric features of airfoils with the help of mathematical transformations. (**Apply**)
CO 4	**Describe** the concept of lift generation and the factors for efficient wing design. (**Understand**)
CO 5	**Determine** the skin friction drag over surfaces. (**Apply**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	H									M			H		
CO 2	H												H		
CO 3	H				L							M	H		
CO 4	H											M	H		
CO 5	H									M			H		

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18PCAE403	AIRCRAFT PROPULSION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Aero – Thermodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the basics of propulsion, working of different parts of a gas turbine engine, their design and analysis.					

UNIT I FUNDAMENTALS OF ENGINES 7

Gas turbine engine cycle - Engine performance parameters – Efficiencies, Methods of thrust augmentation – Characteristics of propeller, turboprop, turbofan and turbojet engines.

UNIT II INLETS AND NOZZLES 11

Subsonic inlets– External and internal flow pattern – inlet performance criterion –Boundary layer separation – Supersonic inlets – the starting problem – external deceleration– Exhaust nozzles –Theory of flow in isentropic nozzles – Losses in nozzles –Nozzle efficiency— nozzle choking –Over expanded and under expanded nozzles – Ejector and variable area nozzles

UNIT III COMPRESSORS 9

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Concept of pre whirl – Rotation stall – Operating Principle of axial flow compressor – Velocity triangles – degree of reaction – Centrifugal and Axial compressor performance characteristics.

UNIT IV COMBUSTION CHAMBERS 9

Classification of combustion chambers - Combustion process – Stoichiometric Ratio – Equivalence Ratio – Important factors affecting combustion chamber design — Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – flame holders.

UNIT V TURBINES 9

Operating Principle of axial flow turbine – Stator and rotor blades – losses in the blade – choice of blade profile, chord and pitch – stage and overall performance – blade cooling – radial flow turbine.

TEXTBOOKS:

1. Ganesan, V., Gas Turbines, Tata McGraw Hill Publications, Third Edition (Units 1, 3, 4 & 5)
2. Hill, P.G. & Peterson, C.R, Mechanics & Thermodynamics of Propulsion, Addison – Wesley Longman INC, 1999. (Unit 2)

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and SaravanaMuttoo, H.I.H., Gas Turbine Theory, Longman, 1989.
2. Ahmed F. El-Sayed, Aircraft Propulsion and Gas turbine engines, CRS Press, 2008
3. Saeed Farokhi, Aircraft Propulsion, John Wiley & Sons, Inc ., 2009
4. Rolls Royce Jet Engine – 5thEdition – 1996.
5. Oates, G.C., Aero thermodynamics of Aircraft Engine Components, AIAA Education Series.

WEBLINKS:

https://freevideolectures.com/course/3008/jet-aircraft-propulsion
https://cosmolearning.org/courses/introduction-jet-propulson/

COURSE OUTCOMES															
CO 1	**Compare** the performance characteristics of turbojet, turbofan, turboprop and propeller engines. **(Understand)**														
CO 2	**Identify** the engine starting problems associated with inlets. **(Understand)**														
CO 3	**Discuss** the types of nozzles and the losses in nozzles. (**Understand**)														
CO 4	**Explain** the working principle of axial and centrifugal flow compressors. **(Understand)**														
CO 5	**Discuss** important factors affecting combustion chamber design and the problems associated with flame stabilization. (**Understand**)														
CO / PO MAPPING **L –LOW, M – MEDIUM, H – HIGH**															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H									L				H	
CO 2	H													H	
CO 3	H											H		H	
CO 4	H									L		H		H	
CO 5	H											H		H	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE404	AIRCRAFT SYSTEMS AND INSTRUMENTATION	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enlighten the student about the various systems and instruments necessary for the operation of a flight vehicle.

UNIT I AIRCRAFT SYSTEMS 6

Hydraulic systems - Study of typical workable system - components –Hydraulic systems controllers – Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system- Typical Pneumatic power system - Components, Landing Gear systems – Classification.

UNIT II AIRPLANE CONTROL SYSTEMS 8

Conventional Systems - fully powered flight controls - Power actuated systems – Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology.

UNIT III ENGINE SYSTEMS 6

Fuel systems for Piston and jet engines, - Components of multi engines. Lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV AUXILIARY SYSTEMS 5

Basic Air cycle systems - Vapour Cycle systems, Evaporative vapour cycle systems - Oxygen systems - Fire protection systems, Deicing and anti-icing systems.

UNIT V AIRCRAFT INSTRUMENTS 5

Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators - Mach Meters - Altimeters - Principles and operation – Operation and Working Principle of various types of engine instruments – Tachometers, Temperature gauges, Pressure Gauges.

TEXTBOOKS:

1. General Hand Books of Airframe and Powerplant Mechanics, U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, NewDelhi1995.

REFERENCES:

1. Mekinley, J.L. and Bent, R.D., Aircraft Power Plants, McGraw-Hill, 1993.
2. Pallet, E.H.J., Aircraft Instruments & Principles, Pitman & Co., 1993.
3. Treager, S., Gas Turbine Technology, McGraw-Hill, 1997.

WEBLINKS:

http://www1.rmit.edu.au/courses/c6011aero53861105
https://www.canvas.net/browse/erau/courses/aviation-101

COURSE OUTCOMES	
CO 1	**Identify** the components of Hydraulic, Pneumatic, Landing gear and brake system. (**Understand**)
CO 2	**Compare** the advantages and disadvantages of conventional and modern flight control systems. (**Understand**)

CO 3	**Explain** the operating principle of various systems associated with the aircraft engines. (**Understand**)
CO 4	**Describe** the working principle of air-conditioning, oxygen, fire protection and ice protection systems. (**Understand**)
CO 5	**Describe** the operating principle of flight and navigation instruments. (**Understand**)
CO 6	**Summarize** the working principle of engine instruments such as tachometers, temperature gauges and Pressure gauges. (**Understand**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	H									M			L	H	L
CO 2	H														
CO 3	H													H	
CO 4	H									M				H	
CO 5	H													H	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE405	MANUFACTURING TECHNOLOGY	L	T	P	C
	Total Contact Hours – 30	3	0	0	3
	Prerequisite – Engineering Graphics & Design				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To help the student to understand about the different types of manufacturing processes and the uniqueness of different methods.					

UNIT I METAL WORKING PROCESS 5

Mechanical working of metals –hot and cold working –rolling, extrusion, spinning, wire-drawing, press working. Welding – different types of gas and arc welding process, soldering and brazing. Casting –different types, furnaces

UNIT II MACHINING PROCESSES 7

Lathe – introduction, types, construction, mechanisms and attachments for various operations, nomenclature of single point cutting tool. Capstan and turret lathes various mechanisms, tool and loading arrangement. Automatic lathes - single spindle and multi spindle mechanisms, Introduction to CNC machining

UNIT III SHAPER, PLANER AND MILLING PROCESSES 7

Shaper, planer and slotter: types, specifications, mechanisms, holding devices, difference between shaper and planer. Milling machine – types and specification, mechanisms, holding devices, milling operations.

UNIT IV DRILLING, BORING, BROACHING, SURFACE FINISHING PROCESSES 6

Drilling, Boring- Specification, Nomenclature of drilling and reaming tool and its specification. Broaching: Specification, types, mechanisms, nomenclature of broaching tool. Grinding process, Types of grinding machines, Grinding Wheels, Honing, Super finishing, Polishing, Metal spraying, Galvanizing, Electroplating.

UNIT V NON – TRADITIONAL MACHINING PROCESSES 5

Non-traditional machining techniques, classification, Abrasive jet machining, Electrical Discharge Machining, E. D wire cutting, Electro chemical machining, Electron Beam Machining, Laser Beam Machining, Ultrasonic Machining – Introduction to 3D Printing

TEXTBOOKS:

1. HajraChowdary S.K, The fundamentals of work shop technology Vol. I & II, Media publishers, 1997.

REFERENCES:

1. W.A.J. Chapman., Workshop Technology. Vol I, II& III, 1975, ELBS.
2. Roy A Lindberg, Process and Material Manufacture, PHI, 1995.
3. Kalpakjan, Manufacturing Engineering and Technology, Addison Wesley, 2005.
4. P.C. Sharma., A text book of Production Technology, S.Chand& Company ltd, 2007.
5. P.N.Rao. Manufacturing Technology-Foundry Forging and Welding, TMH publishing co, 2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_me03
https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x-0

COURSE OUTCOMES															
CO 1	**Describe** various metal forming process and different types of welding. (**Understand**)														
CO 2	**Describe** types of lathe and their construction. (**Understand**)														
CO 3	**Explain** the process of shaping, planing and milling operations. (**Understand**)														
CO 4	**Discuss** the process involved in drilling, boring, broaching, surface finishing. (**Understand**)														
CO 5	**Describe** the working principle of various Non-traditional machining techniques. (**Understand**)														
CO / PO MAPPING **L –LOW, M – MEDIUM, H – HIGH**															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**	**PS 03**
CO 1	H												H	H	H
CO 2	H										L		H	H	H
CO 3	H												H	H	H
CO 4	H									L			H	H	H
CO 5	H									L			H	H	H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

	AERODYNAMICS LABORATORY	L	T	P	C
U18PCAE4L1	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Fundamentals of Fluid Mechanics, Co-requisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To give to the student a practical experience of using the subsonic wind tunnel to carry out experimentation on different design models and to calculate forces acting on the models based on the experimentation.

LIST OF EXPERIMENTS

1 Calibration of subsonic wind tunnel.
2 Pressure distribution over smooth cylinder
3 Pressure distribution over rough cylinder.
4 Pressure distribution over symmetric airfoil.
5 Pressure distribution over cambered airfoil.
6 Pressure distribution over a wing
7 Force measurement on an Airfoil using wind tunnel balance.
8 Pressure distribution over a building model.
9 Aerodynamic studies of automotive models.
10 Flow visualization at subsonic velocity using (a) Smoke (b) Oil.

REFERENCES:

1. Aerodynamics Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=IdES9fdUh2c
https://www.youtube.com/watch?v=E9ZSAX56m0E
https://www.youtube.com/watch?v=UqBmdZ-BNig

COURSE OUTCOMES	
CO 1	**Carryout** flow analysis over various aerodynamic models. (**Imitation**)
CO 2	**Demonstrate** the usage of mechanical and electronic instruments in data acquisition. (**Manipulation**)
CO 3	**Conduct** experiments at various orientation of models to characterize the flow. (**Articulation**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	H								H	H			H		
CO 2	H								H	H			H		
CO 3	H								H	H		M	H		

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18PCAE4L2	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Nil, Co-requisite – Manufacturing Technology				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To equip the student with the knowledge and practical experience of operating various manufacturing machines like lathes, milling machines, shaper, planer					

LIST OF EXPERIMENTS

1 Study of centre, capstan and automatic lathes and their accessories.
2 Exercise on setting the work piece and the tool in the lathe.
3 Plane turning and step turning.
4 Taper turning and knurling.
5 Eccentric Turning.
6 Thread cutting and grooving.
7 Drilling and reaming.
8 Drilling and boring.
9 Surface grinding
10 Study of milling and grinding machines.

REFERENCES:

1. Machine Shop Lab Manual, Department of Mechanical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=8EsAxOnzEms
http://www.sme.org/fmp/
https://www.youtube.com/watch?v=-9fLQ9NHc4g

COURSE OUTCOMES	
CO 1	**Carry out** different machining operations on center lathe **(Imitation)**
CO 2	**Perform** drilling, reaming and boring processes. **(Precision)**
CO 3	**Observe** the working of Planner shaper miller and grinder. **(Imitation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	H								H			H	H	H	H
CO 2	H								H	M		H	H	H	H
CO 3	H								H			H	H	H	H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE4L3	AERO DESIGN AND MODELING LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To give the students a hands on experience on the design of small gliders, parachutes, paper planes, ornithopters, RC aircraft, quadrotors

LIST OF EXPERIMENTS

1 Design and fabrication of gliders using lightweight materials.
2 Design and fabrication of power gliders.
3 Design and fabrication of single and double crank flapping wing mechanism.
4 Design and fabrication of pivoted double crank flapping wing mechanism.
5 Design and fabrication of wing using lightweight materials.
6 Design and fabrication of horizontal and vertical stabilizer using lightweight materials.
7 Design and fabrication of fuselage using lightweight materials
8 Estimation the discharge rate of Li-Po battery for different thrust setting.
9 Estimating the propeller thrust for different voltage setting.
10 Assembling of Remote Control Aircraft.

REFERENCES:

1. Aero Design and Modeling Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.modelaircraft.org/

COURSE OUTCOMES	
CO 1	**Design** and fabricate the Aircraft Structural components with appropriate materials. (**Naturalization**)
CO 2	**Conduct** flight testing of powered glider and RC plane. (**Precision**)
CO 3	**Observe** Performance characteristics of Glider and RC plane. (**Imitation**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS 03
CO 1	H		H						H	H			H	H	H
CO 2	H		H						H	H			H	H	H
CO 3	H						M		H	H		M	H	H	H
Category	Professional Core (PC)														
Approval	48th Academic Council Meeting														

SEMESTER V

U18PCAE501	AIRCRAFT STRUCTURAL MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the knowledge about the mechanics of different aircraft structural members, and their design.

UNIT I UNSYMMETRICAL BENDING 9

Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method- advantages and disadvantages.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9

Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9

Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear center of closed sections.

UNIT IV BUCKLING OF PLATES 9

Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength by Needham's and Gerard's methods – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width – inter-rivet and sheet wrinkling failures - short panel failing strength.

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE 9

Wing structural arrangements – factors influencing - wing stress analysis methods – determination of shear force and bending moment distribution over fuselage – Numerical problems – Tension field beam – general Wagner equation - Semi-tension field beams.

TEXTBOOKS:

1. Megson T M G, 'Aircraft Structures for Engineering Students', Fifth Edition, Elsevier Aerospace Engineering Series,2007. (Units 1, 2, 3 & 5)
2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999 (Unit 4)

REFERENCES:

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997
3. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985

WEBLINKS:

https://www.sciencedirect.com/topics/engineering/shear-centre
http://nptel.ac.in/courses/105106049/63
https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-21-techniques-for-structural-analysis-and-design-spring-2005/

COURSE OUTCOMES	
CO 1	**Compute** the bending stress distribution in beams of symmetric and unsymmetrical sections. (**Apply**)
CO 2	**Calculate** the shear flow distribution in symmetrical and unsymmetrical thin-walled open section and its shear center. (**Apply**)
CO 3	**Calculate** the shear flow distribution in thin walled single and multi-cell structures subjected to combined loading. (**Apply**)
CO 4	**Compute** the crippling strength of thin plates and effective width of sheet stiffener panels. (**Apply**)
CO 5	**Analyze** the stress developed in aircraft wings and fuselage. (**Analyze**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H									H					H
CO 2	H														H
CO 3	H									H					H
CO 4	H														H
CO 5	H														H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE502	GAS DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the student understand about the flow physics of high speed gases, shocks and high speed aircraft and experimentation techniques.					

(Use of Gas Tables is permitted)

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 9

Compressibility, Continuity, Momentum and Energy equation for steady one dimensional flow, Compressible Bernoulli's equation, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Isentropic relations - Critical conditions, Characteristic Mach number, Maximum discharge velocity.

UNIT II SHOCKS AND EXPANSION WAVES 10

Normal shock relations, Prandtl's relation, Hugonoit equation, Rayleigh Supersonic Pitot tube equation, Oblique shocks, θβM relation, Shock Polar, Reflection of oblique shocks, Left running and Right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, Operating characteristics of convergent and convergent-divergent nozzles.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW 10

Potential equation for 2-dimensional compressible flow, Linearization of potential equation,Small perturbation theory, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics, Wave drag coefficient.

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION 8

Critical Mach number, Drag divergence Mach number, Shock Stall, Shock- Boundary layer interaction, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings.

UNIT V EXPERIMENTAL METHODS 8

Wind tunnels for Subsonic, transonic, Supersonic and hypersonic flows, Various Measurement techniques – velocity, pressure, Flow visualization techniques in high speed flows, Shock tube, Gun tunnels

TEXTBOOKS:

1. Rathakrishnan.. E, Gas Dynamics, Prentice Hall of India, Sixth Edition, 2017.

REFERENCES:

1. Anderson, J. D, Modern Compressible Flow, Third Edition, Tata McGraw-Hill & Co., 2012.
2. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
3. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989.

4. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 19976.
5. Yahya S.M., Fundamentals of Compressible Flows, Third Edition, New Age International Publishers, 2003.

WEBLINKS:
https://onlinecourses.nptel.ac.in/noc17_ae05/course

COURSE OUTCOMES	
CO 1	**Apply** the concepts of isentropic flow for problems related to variable area ducts. (**Apply**)
CO 2	**Calculate** the properties of flow through shock and expansion waves. (**Apply**)
CO 3	**Determine** the aerodynamic coefficients of compressible flows based on linearized flow theory. (**Apply**)
CO 4	**Categorize** various aircrafts intended for subsonic and supersonic regimes based on wing and fuselage design. (**Analyze**)
CO 5	**Describe** flow measurement and visualization techniques for high-speed flows. **(Understand)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS01**	**PS02**	**PSO3**
CO 1	H											H	H	H	
CO 2	H									L		H	H	H	
CO 3	H		L									H	H	H	
CO 4	H				M					L		H	H		
CO 5	H				M							H	H	H	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE503	ADVANCED AEROSPACE PROPULSION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aircraft Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enable the student to understand about the advanced aero engines, rocket engines, electric engines, components and functions.

UNIT I RAMJET PROPULSION 11

Operating principle of ramjet engine – Components of ramjet engines and their efficiencies – Combustion in ramjet engine – Critical, subcritical and supercritical modes of operation - Ramjet engine and its performance characteristics – Ramjet design calculations – Flame stability problems in ramjet combustors –Integral ram rockets.

UNIT II SCRAMJET PROPULSION 9

Introduction to hypersonic vehicles, design challenges and supersonic combustion - problems associated with supersonic combustion– Types of scramjet combustors – Fuel injection schemes in scramjet combustors – Flame Stabilization

UNIT III SOLID PROPELLANT ROCKETS 8

Operating principle – Specific impulse of rocket – Internal ballistics – Selection criteria of solid propellants – propellant grain design considerations – Progressive, Regressive and neutral burning in solid rockets.

UNIT IV LIQUID PROPELLANT ROCKETS 8

Liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets –basics of cryogenic techniques – Cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion - static testing of rockets and safety considerations

UNIT V NON – CONVENTIONAL PROPULSION TECHNIQUES 9

Pulse propulsion – combustion process in pulsejet engines – inlet charging process – Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion - Ion propulsion – Nuclear rocket – Types – Solar Sail - comparison of performance of these propulsion systems with chemical rocket propulsion systems.

TEXTBOOKS:

1. El-Sayed, Ahamed F, “Aircraft Propulsion and Gas Turbine Engines”, CRC Press, 2008 (Unit 1)
2. Corin Segal, “The Scramjet Engine”, Cambridge University Press, 2009 (Unit 2)
3. Ramamurthy, K., “Rocket Propulsion”, Trinity Publishers, 2nd Edition (Units 3, 4 & 5)

REFERENCES:

1. J D Mattingly, “Elements of Propulsion - Gas Turbines and Rockets “, AIAA Education Series, 2006.
2. David H. Heiser and David T. Pratt., “Hypersonic Air -breathing Propulsion”, AIAA Education Series, 1999.
3. DanM.Goebel, Ira Katz, ‘Fundamentals of Electric Propulsion’, John Wiley & Sons Inc, New York, 2003.
4. Thomas A Ward, “Aerospace Propulsion Systems”, John Wiley & Sons Inc., New York, 2010.

5. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 7th Edition, 2001

WEBLINKS:
https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-512-rocket-propulsion-fall-2005/

COURSE OUTCOMES															
CO 1	**Explain** the working principle, modes of operation and performance parameters of Ramjet engine. **(Understand)**														
CO 2	**Discuss** supersonic combustion andthe challenges involved in scramjet design. **(Understand)**														
CO 3	**Explain** the operating principle of solid propellant rockets and selection of propellant grain**. (Understand)**														
CO 4	**Describe** various feed systems, cooling methods in liquid propellant rockets. **(Understand)**														
CO 5	**Explain** the working principle andthe practical limitations of hybrid rockets. **(Understand)**														
CO / PO MAPPING **L –LOW, M – MEDIUM, H – HIGH**															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H													H	
CO 2	H													H	
CO 3	H													H	
CO 4	H									M				H	
CO 5	H									M				H	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE504	AIRCRAFT PERFORMANCE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the knowledge of estimating the performance parameters of an aircraft and its design.

UNIT I AERODYNAMICS OF THE AIRPLANE 10

International Standard Atmosphere, TAS, IAS and EAS, , Aerodynamic Lift, Drag and Moments – Lift, Drag and Moment Co-efficient- Aerodynamic Center – NACA airfoil nomenclature – Streamlined and Bluff body – Skin friction Drag, Pressure Drag and Induced Drag – Drag Polar – Various drags of an airplane – Methods of Drag Reduction – Mach Number – Effect on Drag Polar.

UNIT II AIRCRAFT ENGINE PERFORMANCE 10

Power available and power required curves- Thrust available and thrust required curves- Conditions for power required and thrust required minimum-Thrust available and maximum velocity, Power available and maximum velocity-Altitude effects on power available and power required-thrust available and thrust required-Effect of drag divergence on maximum velocity.

UNIT III STEADY LEVEL FLIGHT 10

Steady level flight, the fundamental Parameters: Thrust – to – weight ratio, Wing loading, Drag polar, and lift-to – drag ratio. Aerodynamic relations associated with lift-to-drag ratio, Range and Endurance of Propeller and Jet aircrafts

UNIT IV GLIDING AND CLIMBING FLIGHT 8

Equation of motion for Rate of climb- Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- , Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V ACCELERATED FLIGHT 7

Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, bank angle and load factor, Constraints on load factor, Pull up and pull down maneuvers, V-n diagram.

TEXTBOOKS:

1. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 2010.

REFERENCES:

1. Miado Saarlas, Aircraft Performance, John Wiley & Sons, 2007
2. Torenbeek E and Wittenberg H, Flight Physics, Springer, 2009
3. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999.
4. Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004
5. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Amold Publishers, 1988

WEBLINKS:

https://swayam.gov.in/course/1316-introduction-to-airplane-performance

COURSE OUTCOMES	
CO 1	**Describe** basic principles relating to drag polar equation of the aircraft. (**Understand**)
CO 2	**Examine** the aircraft engine performance. (**Apply**)
CO 3	**Calculate** range and endurance for power and thrust producing engine under various flight conditions. (**Apply**)
CO 4	**Examine** climb and glide performance for shallow and steep angles. (**Apply**)
CO 5	**Calculate** take off, landing and turning performance under various flight conditions. (**Apply**)

CO / PO MAPPING

L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H												H		
CO 2	H												H	H	
CO 3	H												H	H	
CO 4	H									M			H		
CO 5	H									M			H		
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE505	CONTROL SYSTEMS	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Basic Electrical and Electronics Engg				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the various methods necessary to carry out the design and analysis of aerospace control systems.

UNIT I SYSTEM AND REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – Block diagram reduction techniques

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input- I and II order system response – Error coefficients – Generalised error series – Steady state error- P, PI, PID modes of feedback control – Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response – Bode plot- polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT IV CONCEPT OF STABILITY 9

Characteristics equation – Root Locus construction - Routh Hurwitz stability criterion

UNIT V SAMPLED DATA SYSTEMS 9

Sampled data control systems- functional elements – sampling process- z-transforms- properties inverse z transforms – ZOH and First Order Hold process- pulse transfer functions – step response – Introduction to digital control system, Digital Controllers and Digital PID controller

TEXTBOOKS:

1. Nagarath.I.J. and Gopal M, " Control System Engineering', New Age International Publishers, New Delhi, 2015. (Units 1 to 4)
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995 (Unit 5)

REFERENCES:

1. OGATO, Modern Control Engineering, Fifth Edition, Prentice-Hall of India Pvt.Ltd., New Delhi, 2010.
2. Kuo, B.C. Automatic Control Systems, Prentice-Hall of India Pvt.Ltd., New Delhi, 2009.
3. Azzo, J.J.D. and C.H. Houpis, Feedback Control System Analysis And Synthesis, McGraw-Hill International 3rd Edition, 1998.
4. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi, 1998.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_ee41/course

COURSE OUTCOMES	
CO 1	**Analyze** mathematical model for mechanical and Electrical systems. **(Analyze)**
CO 2	**Analyze** time response of the system with various test inputs and steady state errors. (**Analyze**)
CO 3	**Analyze** the frequency response of the system and correlate frequency - time domain

	specifications. (**Analyze**)														
CO 4	**Predict** the stability of the system using Root Locus and Routh Hurwitz stability criterion. (**Evaluate**)														
CO 5	**Discuss** the basic components of Digital Control System. **(Understand)**														
CO / PO MAPPING::L –LOW, M – MEDIUM, H – HIGH															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H														
CO 2	H									M					
CO 3	H														
CO 4	H									M					
CO 5	H														
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE5L1	**AIRCRAFT STRUCTURES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**4**	**2**
	Prerequisite – Elements of Aerospace Structures, Co-requisite – Aircraft Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the structural analysis of different aircraft parts, shear centers, combined loading					

LIST OF EXPERIMENTS

1 Verification of Maxwell's theorem and principle of superposition.
2 Column – Testing.
3 Testing of riveted joints.
4 Unsymmetrical Bending of a Beam
5 Determination of Shear Centre in open Section
6 Determination of Shear Centre in closed Section
7 Combined bending and Torsion of a Hollow Circular Tube
8 Constant Strength Beams
9 Wagner beam – Tension field beam
10 Material properties test of composite laminate

REFERENCES:

1. Aircraft Structures Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=Na7vONvHqOc
https://www.youtube.com/watch?v=SH_NlsDe3jE
https://www.youtube.com/watch?v=EEQqmYPOLIQ

COURSE OUTCOMES	
CO 1	**Demonstrate** structural mechanics principles/phenomenon using simple experiments. **(Manipulation)**
CO 2	**Observe** deformation of structural members or/and failure of materials under given loads. **(Imitation)**
CO 3	**Perform** comparative study between the obtained experimental results and theoretical values.**(Precision)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H								H	H					H
CO 2	H								H	H					H
CO 3	H								H	H					H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE5L2	AIRCRAFT MAINTENANCE LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Aircraft Systems and Instruments				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the students with the basic inspection, repair and maintenance practices carried out for aircrafts.

LIST OF EXPERIMENTS

1 Aircraft systems observations during Ground run.
2 Aircraft "Mooring" and "Leveling" procedure.
3 Control System "Rigging check" procedure
4 Aircraft "Symmetry Check" procedure
5 Procedure to find the centre of gravity of Aircraft
6 Piston Engine – Cleaning, Visual Inspection. NDT Checks
7 Piston Engine Components – Dimensional Checks
8 Jet Engine – Identification of Components and Defects
9 Tube Bending and Flaring
10 Sheet Metal Forming

REFERENCES:

1. Aircraft Systems Lab Manual, Department of Aeronautical Engineering, 2017
2. Airframe and Aero Engine Repair Lab Manual, Department of Aeronautical Engineering, 2017.

WEBLINKS:

https://www.youtube.com/watch?v=pmJmwkrkcC8

COURSE OUTCOMES	
CO 1	
CO 2	
CO 3	

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H						H		H	H				H	
CO 2	H						H		H	H	M			H	
CO 3	H						H		H	H					M

Category	Professional Core (PC)
Approval	48th Academic Council Meeting

U18PCAE5L3	FLIGHT SIMULATION LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint with the basic starting and operation of a Cessna 172 aircraft through a flight simulator					

LIST OF EXPERIMENTS

1 Specification of Cessna C-172 –S
2 Cessna-172 Trainer Aircraft Operational Check
3 Study of Cessna – 172 Flight Simulators
4 Demonstrate the Autopilot Mode and Automatic Direction Control Mode of Cessna 172 Trainer Aircraft
5 Demonstration of Takeoff and Landing in Cessna-172 Trainer Aircraft using Flight Simulator
6 Demonstration of Basic Aircraft Instruments
7 Study of Ring Laser Gyro
8 Study of Fly-By-Wire and Fly-By-Light
9 Demonstration of Lateral Autopilot
10 Demonstration of Longitudinal Autopilot

REFERENCES:

1. Flight Simulation Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.digitaltrends.com/gaming/best-free-flight-simulators/

COURSE OUTCOMES	
CO 1	**Recognize**features of theflight simulatorand observe basic operational procedure (pre-takeoff, takeoff and landing) for flying Cessna – 172 aircraft **(Understand).**
CO 2	**Identify** the basic aircraft instruments and their application during takeoff and landing **(Understand).**
CO 3	**Demonstrate** takeoff, autopilot and landing Cessna-172 **(Understand).**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PS O1	PS O2	PS O3
CO 1													L		
CO 2													L	L	
CO 3													L	L	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE5L4	SIMULATION TOOL FOR AEROSPACE APPLICATIONS	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Mathematics I & II				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint with the MATLAB application to solve various engineering problems.

LIST OF EXPERIMENTS

1 Introduction to MATLAB
2 Relational and Logical Expressions in MATLAB
3 Working with Matrices
4 Plotting using MATLAB
5 Exercise on Curve Fitting
6 Exercise on Complex and Statistical Analysis
7 Program Flow Control in MATLAB
8 Input and Output of Variables
9 Exercise on solving ODE's and PDE's
10 Exercise on using SIMULINK for dynamic simulation.

REFERENCES:

1. MATLAB Lab Manual, Department of Aeronautical Engineering, 2018.

WEBLINKS:

https://www.mathworks.com/support/learn-with-matlab-tutorials.html

COURSE OUTCOMES	
CO 1	**Master** thebasic computing and programming features of MATLAB **(Precision).**
CO 2	**Perform** data plotting, curve fitting and statistical analysisin MATLAB**(Precision).**
CO 3	**Adapt**MATLAB to solve engineering-related problems using numerical methods and in performing dynamic simulation **(Articulation).**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H				H										
CO 2	H				H								H	H	H
CO 3	H				H								H	H	H
Category	Professional Core (PC)														
Approval	48th Academic Council Meeting														

SEMESTER VI

U18HSBA601	ORGANIZATIONAL BEHAVIOR	L	T	P	C
	Total No. of contact hours: 45	3	0	0	3
	Pre-requisite: Nil				
	Course Designed by: Dept of Management Studies				

Course Objectives

1. Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups
4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
5. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

UNIT I **9 hours**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9 hours**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9 hours**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9 hours**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9 hours**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

COURSE OUTCOMES (COs)	
CO1	**Identify** the frame work of Organizational Behaviour.**(Remember)**
CO2	**Infer** concepts of Interpersonal perception. **(Understand)**
CO3	**Compare** the Merits and Demerits of Group decision making.**(Understand)**
CO4	**Describe** the approach of leadership and Summarize the Sources of power.**(Remember)**

CO5	**Relate** change, conflict and culture of management. **(Understand)**

CO / PO MAPPING **L –LOW, M – MEDIUM, H – HIGH**															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1					H	H	H			L					
CO 2					H	H	H								
CO 3					H	H	H								
CO 4					H	H	H								
CO 5					H	H	H			L					
Category	**Humanities and Sciences (HS)**														
Approval	**48th Academic Council Meeting held in Aug, 2018**														

U18PCAE601	FINITE ELEMENT ANALYSIS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the student with basic numerical techniques called finite element techniques to analyze structural components.

UNIT I INTRODUCTION 9

Introduction to FEA - historical background - Review of various approximate methods – Rayleigh Ritz method, Weighted residual methods - Convergence criteria - Fundamentals of Finite Element Modeling – Element Division - Numbering Scheme - Examples of Finite Element Modeling

UNIT II ONE DIMENSIONAL SYSTEMS 9

Direct stiffness method – spring element- Derivation of the stiffness matrix- Example of a spring assemblage-Assembly of global stiffness matrix-Types of boundary conditions- The Potential energy approach –Examples- bar element – Coordinate systems and Shape Functions- The Potential Energy Approach- Assembly of Global Stiffness Matrix and Load Vector - Boundary Conditions- Temperature Effects – Heat transfer problems in 1D bar and wall

UNIT III TWO DIMENSIONAL SYSTEMS 9

Beam element – element stiffness – load vector – global stiffness matrix – boundary conditions – solution, Plane truss structure - Coordinate Transformation – Local & Global Coordinate- The Element Stiffness Matrix- Stress Calculations- Temperature Effects – Examples.Plane stress & strain – Constant Strain Triangle (CST)- Potential Energy Approach - Element Stiffness; Force Terms, Stress Calculations- Temperature Effects- Examples

UNIT IV THREE DIMENSIONAL SYSTEMS 9

Axisymmetric formulation – Element stiffness matrix and force vector – Body forces and temperature effects – Stress calculations – Boundary conditions and Nodal Solution; Mapping and Numerical Integration—Applications to cylinders under internal or external pressures – Rotating discs - Isoparametric Representation- Four noded quadrilateral for axisymmetric problems

UNIT V APPLICATIONS OF FEM TO AEROSPACE STRUCTURES 9

Linear static analysis-non linear static analysis –dynamic analysis-simple harmonic motion-damping consideration-forced vibration -Case studies and problems using software packages and programming.

TEXTBOOKS:

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu", Introduction to Finite Elements in Engineering", Prentice Hall India,Fourth Edition, 2011.

REFERENCES:

1. Reddy J.N.,"An Introduction to Finite Element Method ",McGraw Hill , 3rd edition, 2005.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2nd 2001.
3. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.

4. Rao. S.S., “Finite Element Methods in Engineering”, Butterworth and Heinemann, Fourth Edition, 2005.
5. Daryl L. Logan, “A First Course in the Finite Element Method”, 5th Edition, PWS Publishing Company, Boston, 2010.

WEBLINKS:

https://nptel.ac.in/courses/112104116/

COURSE OUTCOMES															
CO 1	**Compare** various functional approximation methods for structural problems. (**Analyze**)														
CO 2	**Calculate** the nodal field variables for one dimensional structure. (**Apply**)														
CO 3	**Determine** the stiffness matrix and stress developed in two dimensional structures. (**Apply**)														
CO 4	**Calculate** the nodal displacements and stress for axi-symmetric structures. (**Apply**)														
CO 5	**Analyze t**he static and dynamic behavior of structures. (**Analyze**)														
CO / PO MAPPING::L –LOW, M – MEDIUM, H – HIGH															
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H									M					H
CO 2	H											M			H
CO 3	H											M			H
CO 4	H									M					H
CO 5	H				L										H
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE602	AIRCRAFT STABILITY AND CONTROL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To make the students understand the concept of stable and non-stable configuration of airplanes.

UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 12

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing

UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 11

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery

UNIT III STATIC LATERAL STABILITY AND CONTROL 8

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

UNIT IV DYNAMIC LONGITUDINAL STABILITY 8

Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 6

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

TEXTBOOKS:

1. Nelson, R.C. "Flight Stability & Automatic Control", McGraw Hill, 1998.

REFERENCES:

1. McCormick, B.W. "Aerodynamics, Aeronautics & Flight Mechanics", John Wiley, 1995.
2. Babister, A.W. "Aircraft Stability and response", Pergamon Press, 1996.
3. Etkin, B., "Dynamics of Flight Stability and Control", John Wiley, New York, 1982.
4. Perkins C.D. &Hage R.E. "Airplane performance, stability and control", John Wiley & Sons 1976.
5. Pamadi, B.N.,"Performance, Stability, Dynamics, and Control of Airplanes", AIAA Education Series, 2004

WEBLINKS:

https://nptel.ac.in/courses/101104062/10

COURSE OUTCOMES	
CO 1	**Describe** criteria of static longitudinal stability under stick fixed and stick free conditions. (**Understand**)
CO 2	**Estimate** the contribution of aircraft components on static directional stability and the rudder effectiveness for different flight conditions. (**Apply**)
CO 3	**Estimate** the contribution of aircraft components on static lateral stability and compute the effectiveness of aileron. (**Apply**)
CO 4	**Estimate** dynamic longitudinal stability derivatives under non equilibriumconditions of aircraft. (**Apply**)
CO 5	**Compute** the stability derivatives for lateral and directional dynamics of aircraft. (**Apply**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	H												M		
CO 2	H												M	L	
CO 3	H												M		
CO 4	H									M			M		
CO 5	H									M			M	L	
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE6L1	**COMPUTER AIDED ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**4**	**2**
	Prerequisite – Elements of Aerospace Structures, Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with various computer software for engineering analysis					

LIST OF EXPERIMENTS

1 Study of commercial software packages and their tools
2 Stress analysis of beams with different loading conditions
3 Stress analysis of a plate with circular hole
4 Stress analysis of an axisymmetric component
5 Vibration analysis of cantilever beam
6 Simple conduction example
7 Thermal mixed boundary example
8 Flow field analysis of jets
9 Flow field simulation over an airfoil
10 Fluid – Structure interaction

REFERENCES:

1. CAA Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.ansys.com/en-in/academic/free-student-products/support-resources

COURSE OUTCOMES	
CO 1	**Carry out** elementary mechanical coupon testing of materials as per the given procedure**. (Imitation)**
CO 2	**Acquire** data using the available measuring devices. **(Manipulation)**
CO 3	**Perform** basic mathematical calculation using the appropriate formulae and represent the results in form of graph and table**.(Precision)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H				H				H	H		H			H
CO 2	H				H				H	H		H			H
CO 3	H	L			H				H	H		H	H		
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAE6L2	PROPULSION LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Low Speed Aerodynamics, Aircraft Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To give an experience on experimentation with fluid jets, combustion and heat transfer.

LIST OF EXPERIMENTS

1 Estimation of spread rate in incompressible circular jets.
2 Estimation of spread rate in incompressible non- circular jets.
3 Estimation of centre line velocity decay in supersonic circular jets.
4 Estimation of centre line velocity decay in supersonic non-circular jets.
5 Determination of Wall jet velocity profile.
6 Supersonic Jet Pattern Analysis using Schlieren Technique.
7 Study of free convective heat transfer over a flat plate.
8 Study of forced convective heat transfer over a flat plate.
9 Operation of a subsonic Ramjet engine.
10 Determine the calorific value of Fuel using Bomb Calorimeter.

REFERENCES:

1. Propulsion Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=PxYfyUNQi5k
https://www.youtube.com/watch?v=27IsaLGoRBE

COURSE OUTCOMES	
CO 1	**Demonstrate** the various procedures and techniques for the experiments. (**Manipulation**)
CO 2	**Observe** the data using the different measuring devices and techniques. (**Imitation**)
CO 3	**Follow** the mathematical concepts/equations to obtain quantitative results. (**Imitation**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PS O1	PS O2	PS O3
CO 1	H								H	H		M		M	
CO 2	H								H	H		M		M	
CO 3	H								H	H				M	
Category	Professional Core (PC)														
Approval	48th Academic Council Meeting														

U18EEAE6L1	AIRCRAFT DESIGN PROJECT I	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Flight Mechanics, Engineering Graphics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to carry out a preliminary design of an aircraft.					

LIST OF EXPERIMENTS

1 Comparative configuration study of different types of airplanes
2 Comparative study on specification and performance details of aircraft
3 Preparation of comparative data sheets
4 Work sheet layout procedures
5 Comparative graphs preparation.
6 Selection of main parameters
7 Preliminary weight estimations.
8 Power plant selection.
9 Aerofoil selection
10 Wing and stabilizers selection.
11 Control surfaces designing.
12 Drag estimation
13 Detailed performance calculations
14 Stability Estimates
15 Preparation of layouts of balance diagram and three view drawings

REFERENCES:

1. Aircraft Design Project Reference Guide, "E. Tulapurkara", NPTEL, 2017
2. Aircraft Performance and Design, "John D Anderson", Tata McGraw Hill Publications
3. Nelson, R.C." Flight Stability & Automatic Control", McGraw Hill, 1998.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_ae08/

COURSE OUTCOMES	
CO 1	**Acquire**the design parameters of various aircrafts necessary for the suitable preliminary design. **(Manipulation)**
CO 2	**Acquire** aerodynamic and geometric parameters for detailed aircraft design. **(Manipulation)**
CO 3	**Integrate** performance and stability parameters for different phases of flight. **(Precision)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PS O1	PS O2	PS O3
CO 1	H								H	H		H	H	H	H
CO 2	H								H	H		H	M		
CO 3	H								H	H		H	M	M	

Category	**Employability Enhancement (EE)**
Approval	**50th Academic Council Meeting held in Jun, 2018**

SEMESTER VII

U18PCAE701	**COMPUTATIONAL FLUID DYNAMICS IN AEROSPACE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Low Speed Aerodynamics, Numerical Methods				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To equip the student with the knowledge of various numerical techniques to carry out flow analysis.					

UNIT I GOVERNING EQUATIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations. Time-Averaged Equations for Turbulent flow – Reynolds Stress Equations.

UNIT II FDM AND FVM FOR DIFFUSION PROBLEMS 10

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady One, Two and Three dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FVM FOR CONVECTION – DIFFUSION PROBLEMS 9

Steady one-dimensional convection diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes. - SIMPLE, SIMPLER algorithms.

UNIT IV TURBULENCE MODELING 9

Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models. Large eddy simulation- Direct numerical simulation.

UNIT V APPLICATIONS 8

Large Scale problems in CFD – Iterative Solvers – Preconditioning Techniques – Vector and Parallel Computing – Post Processing for Visualization – CFD analysis using commercial packages and programming

TEXTBOOKS:

1. H.K. Versteeg and W. Malalasekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", Longman Scientific & Technical, 2007. (Units 1 to 3)
2. JiyuanTu, Guan, HengYeoh, Chaoqun Liu, "Computational Fluid Dynamics A Practical Approach" Springer Verlag, 2012. (Units 4 & 5)

REFERENCES:

1. J. D. Anderson, "Computational Fluid Dynamics", McGraw Hill International, 2012.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
3. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.

WEBLINKS:

http://www.cfdonline.com

https://onlinecourses.nptel.ac.in/noc16_ch02

COURSE OUTCOMES	
CO 1	**Describe** governing equations of fluid dynamics. (**Understand**)
CO 2	**Apply** appropriate Finite Difference method and Finite volume method for solving diffusion problems. (**Apply**)
CO 3	**Analyze** various explicit and implicit schemes in Finite Volume Method for solving one dimensional convection diffusion problems. (**Analyze**)
CO 4	**Identify** suitable turbulence model for fluid flow problems. (**Understand**)
CO 5	**Analyze** Computational Fluid Dynamics problems by using packages and programming software. (**Analyze**)

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H									M			H		
CO 2	H											H	H		
CO 3	H												H		
CO 4	H									M		H	H		
CO 5	H											H	H		

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18PCAE702	INTRODUCTION TO AVIONICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electricals and Electronics Engg				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To provide the students an understanding of avionics in civil and military industry, avionics subsystems, integrated systems and design approaches

UNIT I OVERVIEW 9

Introduction to aircraft – Axes system – Parts, importance and role of Avionics- systems which interface directly with pilot – Aircraft state sensor systems – Navigation systems- – External world sensor systems – task automation systems- Avionics architecture evolution. Avionics Data buses – MIL STD 1553, ARNC 429.

UNIT II RADIO NAVIGATION 9

Types of Radio Navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS

UNIT III INERTIAL AND SATELLITE NAVIGATION SYSTEMS 9

Inertial sensors – Gyroscopes, Accelerometers, Inertial navigation systems – Block diagram, Platform and strap down INS, Satellite Navigation – GPS

UNIT IV AIR DATA SYSTEMS AND AUTOPILOT 9

Air data quantities – Altitude, Airspeed, Mach no., Vertical speed, Total Air temperature, Stall warning, Altitude warning. Autopilot – basic principles – longitudinal and lateral autopilot. Digital Fly by wire.

UNIT V COCKPIT DISPLAYS 9

Display technologies –LED, LCD, CRT, Flat Panel Display, Primary Flight parameter displays – Head UP Display, Helmet Mounted Display, Night vision goggles, Head Down Display, MFD, MFK, Virtual cockpit.

TEXTBOOKS:

1. Albert Helfrick. D, ‘ Principle of Avionics’, Avionics Communications Inc., 2004
2. Collinson, R.P.G, ‘Introduction to Avionics’, Chapman and Hall, 1996

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. ‘Digital Avionics Systems’, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3. Spitzer, C.R. ‘The Avionics Handbook’, CRC Press, 2000
4. Pallet, E.H.J, ‘Aircraft Instruments and Integrated Systems’, Longman Scientific, 2015

WEBLINKS:

https://www.aea.net/training/

COURSE OUTCOMES	
CO 1	**Discuss** the working principles of various avionic sub-systems and automated flight control systems. **(Understand)**
CO 2	**Discuss** Avionics system architecture and various data-buses. **(Understand)**
CO 3	**Interpret** radio navigation system. **(Understand)**
CO 4	**Discuss** the operational principle ofInertial and Satellite Navigation Systems. **(Understand)**

CO 5	**Explain** Air data Instruments used in modern aircrafts. **(Understand)**
CO 6	**Compare** various display technologies used in civil and military cockpits. **(Understand)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO 1	H														
CO 2	H									M					
CO 3	H														
CO 4	H														
CO 5	H									M					
CO6	H														

Category	**Professional Core (PC)**
Approval	**48th Academic Council Meeting**

U18PCAE7L1	AVIONICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Basic Electricals and Electronics Engg				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the basics of aircraft electronics					

LIST OF EXPERIMENTS

1 Addition/Subtraction of binary numbers.
2 Multiplexer/Demultiplexer Circuits.
3 Encoder/Decoder Circuits.
4 Timer Circuits, Shift Registers, Binary Comparator Circuits.
5 Addition and Subtraction of 8-bit and 16-bit numbers.
6 Sorting of Data in Ascending & Descending order.
7 Sum of a given series with and without carry.
8 Greatest in a given series & Multi-byte addition in BCD mode.
9 Stability analysis using Root locus, Bode Plot techniques.
10 Design of lead, lag and lead – lag compensator for aircraft dynamics.

REFERENCES:

1. Avionics Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.aea.net/training/

COURSE OUTCOMES	
CO 1	**Demonstrate** decoding and encoding operations in digital electronics. (**Manipulation**)
CO 2	**Perform** logical operation and storing the data in microprocessor. **(Precision)**
CO 3	**Design** avionics control system using MATLAB. (**Articulation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	H								H	H					
CO 2	H								H	H					
CO 3	H	L			L				H	H		L			
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18EEAE7L1	AIRCRAFT DESIGN PROJECT II	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Aircraft Structural Mechanics, Aircraft Design Project I				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To introduce to the student about the various kinds of loads acting on an airplane and about the detailed structural design of an aircraft

LIST OF EXPERIMENTS

1 V-n diagram for the design study
2 Gust and maneuverability envelopes
3 Critical loading performance and final V-n graph calculation
4 Structural design study – Theory approach
5 Load estimation of wings
6 Load estimation of fuselage.
7 Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads.
8 Detailed structural layouts.
9 Design of some components of wings, fuselage
10 Preparation of a detailed design report with drawings.
11 Preparation of model using computer aided design packages.
12 Preparation of structural analysis report for wing.
13 Preparation of structural analysis report for Fuselage.
14 Preparation of flow analysis report for wing.
15 Preparation of flow analysis report for fuselage.

REFERENCES:

1. Aircraft Performance and Design, "John D Anderson", Tata McGraw Hill Publications
2. Analysis and Design of Flight Vehicle Structures, E F Bruhn
3. CADD and CAA Lab Manuals, Department of Aeronautical Engineering, 2015

WEBLINKS:

https://www.pce.uw.edu/courses/design-and-analysis-aircraft-structures-1

COURSE OUTCOMES	
CO 1	**Observe** safety flying critical flying load limits. **(Imitation)**
CO 2	**Design** of fuselage and wing structural members. **(Articulation)**
CO 3	**Integrate** all the design parameters to assemble an aircraft. **(Articulation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H	H	H						H	H			L		H
CO 2	H	H	H		H				H	H			L		H
CO 3	H	H	H		H				H	H			M	M	M
Category	**Employability Enhancement (EE)**														
Approval	**48th Academic Council Meeting held in Jun, 2019**														

	PROJECT PHASE I	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
U18EEAE7P1	Prerequisite – Gas Dynamics, Aircraft Structural Mechanics, Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

1. To acquaint the student with theoretical and experimental studies related to aeronautical science.
2. To enable the student to get involved in key area of research in the branch of study.
3. To perform the literature studies and survey that will help in formulating the problem statement.
4. To enable the student to understand the concept of the acquired statement to get the idea about the work.
5. To work according to the acquired idea and to develop report in the form as specified in the guidelines

DESCRIPTION

The objective of the project phase I is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Each student shall finally produce a comprehensive report covering background information, literature survey and problem statement. This final report shall be in typewritten form as specified in the guidelines.

COURSE OUTCOMES	
CO 1	**Observe** the current market scenario to develop new or modify the existing product. **(Imitation)**
CO 2	**Build** a preliminary design of the prototype. **(Manipulation)**
CO 3	**Point out** the methodology for implementation of design. **(Manipulation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	H								H	H		H	L	L	L
CO 2	H								H	H		H	L	L	L
CO 3	H								H	H		H	L	L	L
Category	Employability Enhancement (EE)														
Approval	48th Academic Council Meeting held in Jun, 2019														

SEMESTER VIII

	Project Phase II	L	T	P	C
	Total Contact Hours – 18 periods per week	0	0	18	9
U18PCAE8P1	Prerequisite – Low Speed Aerodynamics, Aircraft Structural Mechanics, Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

1. To introduce to the student about the scientific method of research
2. To accustom the student to the processes involved during a project work
3. To enable the student to understand the concepts of scrutiny to get the idea about the work that takes place during a project
4. To familiarize the student on the preparation of technical reports/paper of his/her project work
5. To enable the student to be able to make a proper presentation of his/her assigned work/project

DESCRIPTION

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Eighteen periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be in typewritten form as specified in the guidelines

COURSE OUTCOMES	
CO 1	**Tell** the value of achieving perfection in projects implementation & completion. **(Imitation)**
CO 2	**Build** the skills, competencies and point of view of designed concepts. **(Naturalization)**
CO 3	**Replicate** professional skills in Presentation, Technical report writing, critical thinking and decision making. **(Manipulation)**

CO / PO MAPPING
L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	H	H	H						H	H			L	L	L
CO 2	H	H	H		H				H	H			L	L	L
CO 3	H	H	H		H				H	H			L	L	L

Category	Employability Enhancement (EE)
Approval	48th Academic Council Meeting

PROFESSIONAL ELECTIVE I (PE I)

U18PEAE011	**AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with the fundamentals aspects of aircraft general engineering and maintenance practices					

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT 10

Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions– Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power unit.

UNIT II GROUND SERVICING OF VARIOUS SUB SYSTEMS 8

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

UNIT III HAZARDOUS MATERIALS AND SAFETY PRACTICES 5

Hazardous materials- characterization – NFPA Hazard Diamond – Hazardous waste handling – Material Safety Data Sheet (MSDS)

UNIT IV INSPECTION 10

Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications

UNIT V AIRCRAFT HARDWARE, MATERIALS AND SYSTEM PROCESSES 12

Hand tools – Precision instruments – Special tools and equipment in an airplane maintenance shop – Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic - Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.

TEXTBOOKS:

1. Aviation Maintenance Technician Handbook, General, AC 65-9A, Shroff Publishers and Distributors, 2008

REFERENCES:

1. Aviation Maintenance Technician Handbook, Airframe, AC 65-15A, Shroff Publishers and Distributors, 2008
2. Kroes Watkins Delp, “Aircraft Maintenance and Repair”, McGraw Hill, 7th edition, New York, 2013.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_ae03

COURSE OUTCOMES	
CO 1	**Discuss** the fundamentals aspects of aircraft maintenance and repair. **(Understand)**
CO 2	**Describe** the repair and maintenance procedures of aircraft structures. **(Understand)**
CO 3	**Explain** the trouble shooting procedures involved in primary aircraft systems. **(Understand)**
CO 4	**Explain** the maintenance procedures of engine and fuel system. **(Understand)**
CO 5	**Summarize** the maintenance procedures of auxiliary and instruments. **(Understand)**

U18PEAE012	ROCKETS AND MISSILES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To learn about the aerodynamics and stability of Rockets and Missiles.					

UNIT I AERODYNAMICS OF ROCKETS AND MISSILES 9

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics – method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – body upwash and body downwash in missiles – rocket dispersion.

UNIT II ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 9

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

UNIT III ROCKET SYSTEMS 9

Ignition system in rockets – types of igniters and igniter design considerations – injection system of liquid rockets and their design considerations – design considerations of liquid rocket thrust chambers – cryo fuel systems – combustion mechanisms of liquid and solid propellants.

UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES 9

Design philosophy behind multistaging of launch vehicles and ballistic missiles – multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics – various types of thrust vector control methods including secondary injection thrust vector control – numerical problems on stage separation and multistaging.

UNIT V MATERIALS FOR ROCKETS AND MISSILES 9

Selection criteria of materials for rockets and missiles – materials for various airframe components and engine parts – materials for thrust control devices – various adverse conditions faced by aerospace vehicles and the requirement of materials to perform under these conditions.

TEXTBOOKS:

1. Ramamurthy K, "Rocket Propulsion", Trinity Publications, 2017. (Units 2, 3 & 5)
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 9th Edition (Units 1 & 4)

REFERENCES:

1. J.D.Mattingly, Elements of Propulsion - Gas Turbines and Rockets, AIAA Education series, 2006,.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.
3. Martin J L Turner, Rocket and Spacecraft Propulsion, Springer-Praxis Publishing, 2001

WEBLINKS:
www.propulsion-analysis.com/
www.rocket.com/design-and-analysis

COURSE OUTCOMES	
CO 1	**Describe** combustion mechanisms in solid and liquid propellant rockets**. (Understand)**
CO 2	**Compute** the forces and moments acting on rockets and missile while passing through atmosphere. **(Apply)**
CO 3	**Analyze** the trajectory of rockets and missiles in free space and gravitational field. **(Analyze)**
CO 4	**Summarize** different thrust vector control techniques and **Solve** stage separation problems inrockets. **(Understand)**
CO 5	**Analyze** the adverse conditions faced by aerospace vehicles and **Identify** suitable materials used for their construction. **(Analyze)**

U18PEAE013	EXPERIMENTAL AERODYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To understand the various experimentation and measurement techniques in the field of aerodynamics.

UNIT I LOW SPEED WIND TUNNEL TESTING 9

Low speed wind tunnels-Power losses in wind tunnel, energy ratio, Calibration, Flow angularity, Yaw Sphere, Yaw meter, Turbulence sphere, Pressure sphere, Wind tunnel balances, boundary layer correction, calculation of CL and CD for airfoils, Magnetic suspension methods

UNIT II HIGH SPEED WIND TUNNEL TESTING 9

High Speed wind tunnels- Blow down, Induction Type Tunnels, Losses in supersonic tunnels, Second throat, running time estimation, transonic, hypersonic tunnels, Shock tunnels, Gun tunnels

UNIT III MEASUREMENT TECHNIQUES 9

Pressure measurement, Hot wire anemometer, laser Doppler anemometer for turbulence and velocity Measurements-Temperature measurement, Measurement of wall shear stress, Rotameters and Ultrasonic flow meters, Laser Doppler velocimetry, Particle image velocimetry,

UNIT IV FLOW VISUALIZATION AND ANALOGUE METHODS 9

Heleshaw Apparatus, Smoke tunnel, Tuft method, chemical coating, interferometer, Shadowgraph method, Schlieren method, laser induced fluorescence, Hydraulic analogy, limitations of analogy

UNIT V DATA ACQUISITION AND UNCERTAINTY ANALYSIS 9

Measurement systems, data acquisition, signal conditioning, multiplexing, data conversion, uncertainty analysis

TEXTBOOKS:

1. Rathakrishnan. E “Instrumentation, Measurement and Experiments in Fluids”, CRC Press, London, 2007

REFERENCES:

1. Rae W.H and Pope. A “Low speed wind tunnel testing” John Wiley Publication, 1999
2. Pope. A andGoin. L “High speed wind tunnel testing” John Wiley, 1985

WEBLINKS:

https://nptel.ac.in/courses/101106040/

COURSE OUTCOMES	
CO 1	**Discuss** calibration procedures using various instruments and **Determine** aerodynamic coefficients. (**Apply**)
CO 2	**Explain** various types of high-speed wind tunnels and discuss their design parameters. **(Understand)**
CO 3	**Describe** measurement techniques for flow properties.**(Understand)**

CO 4	**Explain** different flow visualizations technique in subsonic and supersonic regimes. **(Understand)**
CO 5	**Discuss** data acquisition and error analysis. **(Understand)**

	BOUNDARY LAYER THEORY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
U18PEAE014	Prerequisite – Fundamentals of Fluid Mechanics, Co-requisite – Gas Dynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the various aspects of viscous flow, laminar and turbulent boundary layer, prediction of skin friction drag					

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW 9

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS 9

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER EQUATIONS 9

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER EQUATIONS 9

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modeling

UNIT V COMPRESSIBLE BOUNDARY LAYERS EQUATIONS 9

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

TEXTBOOKS:

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York, 2005.

REFERENCES:

1. Schlichting, H., Boundary Layer Theory, McGraw-Hill, New York, 2000.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc16_me04

COURSE OUTCOMES	
CO 1	**Recall** the fundamental equations of viscous flow and basics of boundary layer theory. **(Understand)**

CO 2	**Discuss** the solutions of simplified viscous flow equations. **(Understand)**
CO 3	**Discuss** theequations and methods used for solving the flow field of laminar boundary layer over a flat plate. **(Understand)**
CO 4	**Describe** the basics of Turbulent boundary layer. **(Understand)**
CO 5	**Describe** the basics of Compressible boundary layer. **(Understand)**

PROFESSIONAL ELECTIVE II (PE II)

U18PEAE021	**CIVIL AVIATION REGULATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To familiarize the student with the various aircraft rules and regulations in India.					

UNIT I CAR SERIES "A" & "B" 9

C.A.R series 'A' - procedure for civil air worthiness Requirements and responsibility operators vis-a-vis Air Worthiness directorate - Responsibilities of operators/owners; procedure of CAR issue, amendments etc; objectives and targets of airworthiness directorate; airworthiness regulations and safety oversight of engineering activities of operations.

C.A.R. series "B" – issue approval of cockpit check list, MEL, CDL - Deficiency list (MEL & CDL); preparation and use of cockpit check list and emergency check list.

UNIT II CAR SERIES "C" & "D" 9

C.A.R. series 'C' - defect recording, monitoring, investigation and reporting- Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.

C.A.R. series 'D'-aircraft maintenance programmes - Reliability Programme (Engines); Aircraft maintenance programme& their approval - On condition maintenance of reciprocating engines; TBO - Revision programme; Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT III CAR SERIES "E" & "F" 9

C.A.R. series 'E' - approval of organizations - Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.

C.A.R. series 'F' - air worthiness and continued air worthiness - Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness

UNIT IV CAR SERIES "L" & "M" 9

C.A.R. series 'L' - aircraft maintenance engineer – licensing - Issue of AME License, its classification and experience requirements, Complete Series 'L'. C.A.R. series 'M' Mandatory Modifications / Inspections.

UNIT V CAR SERIES "T" & "X" 9

C.A.R. series 'T' - flight testing of aircraft - Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued.

C.A.R. series 'X' - miscellaneous requirements - Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use of furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

TEXTBOOKS:

1. " Aircraft Manual (India) ", The English Book Store, 17-1, Connaught Circus, New Delhi.

REFERENCES:

1. " Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA Advisory Circulars ", form DGCA.

WEBLINKS:

https://www.iata.org/training/subject-areas/Pages/civil-aviation-courses.aspx

COURSE OUTCOMES	
CO 1	**Identify** the aircraft airworthiness and to list the responsibilities of owners/operators. **(Understand)**
CO 2	**Discuss** the procedures involved in defect recording, monitoring, investigation, reporting and maintenance programmes. **(Understand)**
CO 3	**Explain** the procedures of approval for aircraft manufacturing and maintenance industries. **(Understand)**
CO 4	**Outline** the procedures followed to conduct AME examinations and license issue. **(Analyze)**
CO 5	**Discuss** the procedures followed in flight testing of aircrafts and the miscellaneous requirements. **(Understand)**

U18PEAE022	THEORY OF ELASTICITY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions					

UNIT I BASIC EQUATIONS OF ELASTICITY 9

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS 9

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES 9

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs

UNIT IV TORSION 9

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS 9

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TEXTBOOKS:

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.

REFERENCES:

1. Enrico Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991.
2. Wng, C.T., "Applied Elasticity", McGraw–Hill Co., New York, 1993.
3. Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw–Hill New York,1978.

COURSE OUTCOMES	
CO 1	**Define** basic elements of theclassical theory of elasticity**(Understand).**
CO 2	**Solve** two dimensional Cartesian problems using Airy's stress function**(Apply).**
CO 3	**Reframe** theclassical theory of elasticity in polar-coordinate system **(Evaluate).**
CO 4	**Analyze** torsion of solid, thick-walled andthin-walled sections**(Analyze).**
CO 5	**Discuss**the classical plate theory**(Understand).**

U18PEAE023	**PRINCIPLES OF TURBOMACHINERY IN AIRBREATHING ENGINES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Aircraft Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To familiarize the student with the basic of turbomachinery in air breathing engines, components and their design.					

UNIT I INTRODUCTION TO TURBOMACHINERY 9

Turbomachinery- definition, Classification of Turbomachines, Power absorbing and power producing turbomachines, Centrifugal compressor-components, Axial compressor-components, Single stage and multi stage, subsonic and transonic axial compressors, Radial turbine-components, Axial turbine-single and multistage, Review of basic laws-conservation of mass, momentum and energy, Euler's turbo machine equation, simple gas turbine cycle, Variation of thrust and SFC with Mach number and altitude for typical turbojet engine

UNIT II CENTRIFUGAL COMPRESSORS 9

Work done and pressure rise, impeller, velocity triangle, slip factor, power input factor, Coriolis acceleration, diffuser, compressibility effects, inlet Mach number for impeller and diffuser, prewhirl, Compressor characteristics, non-dimensional quantities, stage pressure ratio, Instability-surge, rotating stall, choking

UNIT III AXIAL FLOW COMPRESSORS 9

Basic operation, stator, rotor, velocity triangle, factors affecting stage pressure ratio, de Haller number, diffusion factor, degree of reaction, radial equilibrium of fluid element, basic design process, estimation of number of stages, considerations in blade design, blade cascade, compressibility effects, axial compressor characteristics

UNIT IV AXIAL AND RADIAL TURBINES 11

Elementary theory of axial flow turbines, blade loading coefficient, flow coefficient, degree of reaction, rotor blade loss, Vortex theory-Free vortex design, constant nozzle angle design, choice of blade profile, pitch and chord, rotor blade stresses, Firtree root, limiting factors in turbine design, Radial flow turbine

UNIT V MATCHING OF COMPONENTS AND BLADE COOLING 7

Component characteristics-compressor, turbine, off-design operation, load characteristics, equilibrium running, matching of two turbines in series, turbine blade cooling

TEXTBOOKS:

1. Ganesan. V, "Gas Turbines", Tata McGraw Hill Education, 3rd Edition, 2010 (Units 1 to 4)
2. Cohen H, Rogers GFC, and Saravanamuttoo HIH, "Gas Turbine Theory" Addison Wesley Longman Limited, 1998 (Unit 5)

REFERENCES:

1. El-Wakil, M M; Power plant Technology, 1984, McGraw-Hill Pub.
2. NASA-SP-290, Axial Flow turbines, 2002 (re-release), NTIS, USA.
3. J H Horlock, Axial flow compressors, Butterworths, 1958, UK.
4. J H Horlock, Axial Flow Turbines, Butterworths, 1965, UK.
5. B Lakshminarayana; Fluid Mechanics and Heat Transfer in turbomachineries,1995, USA.

6. Nicholas Cumpsty, Compressor Aerodynamics, 2004, Kreiger Publications, USA.
7. Johnson I.A., Bullock R.O. NASA-SP-36, Axial Flow Compressors, 2002 (re-release), NTIS.
8. Ahmed F. El-Sayed; Aircraft Propulsion and Gas Turbine Engines; CRC press, 2008

WEBLINKS:
https://www.coursebuffet.com/sub/aerospace-engineering/415/turbomachinery-aerodynamics

COURSE OUTCOMES	
CO 1	**Recall** basic thermodynamic laws and working principles of Gas Turbines. **(Remember)**
CO 2	**Discuss** the operating principle of centrifugal compressor and **compute** the power input to the compressor. **(Understand)**
CO 3	**Describe** the operating principle of axial flow compressor and compute the power input to the compressor. **(Understand)**
CO 4	**Discuss** the design procedure of compressors. **(Understand)**
CO 5	**Discuss** the basic theory of Turbine design. **(Understand)**

	AIRCRAFT MATERIALS	L	T	P	C
U18PEAE024	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To introduce to the students about the importance of materials in the design of the aircraft

UNIT I INTRODUCTION 9

Properties of Flight Vehicle Materials, Importance of strength to weight ratio and change in properties with respect to temperature variations, factors affecting choice of material for different parts of airplane, Structure of solid materials - crystal structure, effect of crystal imperfections on mechanical properties

UNIT II ALLOYS FOR AIRCRAFT APPLICATIONS 9

Aluminum alloys, High strength and corrosion resistance alloys. Magnesium alloys and their properties, Carbon Steels and Steel Alloys, Effect of alloying elements, Applications of these alloys to aircrafts.

UNIT III HIGH STRENGTH AND HEAT RESISTANT ALLOYS 9

Classification of heat resistant materials, Iron, Nickel and Cobalt base alloys, Refractory materials, Ceramics, Titanium and its alloys, properties of Inconel, Monel & K-Monel, Nimonic and Super Alloys – Applications to Aircrafts

UNIT IV HEAT TREATMENT AND CORROSION RESISTANCE 9

Heat treatment of carbon steel, aluminium alloys, magnesium alloys and titanium alloys used in aircraft. Types of corrosions - Effect of corrosion on mechanical properties - Protection against corrosion - Corrosion resistant materials used in aerospace vehicles.

UNIT V MODERN MATERIALS 9

Significance of Composites and Nanomaterials in Aerospace Engineering, Introduction to graphene, spider silk, silica aerogel, shrilk, stanene and metamaterials and their applications.

TEXTBOOKS:

1. Aircraft Material and Processes: G F Titterton, 5th Edition, Himalayan Books, New Delhi.

REFERENCES:

1. Martin, J.W., "Engineering Materials, Their Properties, and Applications ",Wykedham Publications (London) Ltd., 1987.
2. Titterton, G., "Aircraft Materials and Processes ", V Edition, Pitman Publishing Co., 1995.
3. Krishnadas Nair, C.G., "Handbook of Aircraft Materials ", Interline Publishing, 1993.
4. Balram Gupta, "Aerospace Materials ", Vol. I, Vol. II and Vol. III, S. Chand &Company Ltd., New Delhi -1996.
5. Thiruvadigal, J.D., Ponnusamy,S. and Vasuhi.P.S., Materials Science 5thedition, Vibrant Publications, Chennai, 2007.

WEBLINKS:
https://www.edx.org/course/introduction-to-aerospace-structures-and-materials-0

COURSE OUTCOMES	
CO 1	**Explain** mechanical properties of aircraft structural materials. (Understand)
CO 2	**Classify** different types of alloys and discuss their effects on corrosion resistance. (Understand)
CO 3	**Compare** properties of alloys in high temperature applications. (Anlayze)
CO 4	**Describe** the heat treatment processes of alloys and methods to prevent corrosion. (Understand)
CO 5	**Summarize** the application of advanced materials in aerospace engineering. (Understand)

OPTIONS FOR PROFESSIONAL ELECTIVE (PE) III

U18PEAE031	**VIBRATIONS AND ELEMENTS OF AERO ELASTICITY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To know about the role of vibrations, vibration analysis and ideas about Aero elasticity in engineering and industry and design and analysis of components subject to vibrations.					

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Vibration Terminologies, Simple harmonic motion, Newton's law, D' Alembert's principle, Energy methods, Free vibrations, Damped vibrations, Forced Vibrations with and without damping, support excitation, Transmissibility, Vibration measuring instruments.

UNIT II MULTI DEGREE OF FREEDOM SYSTEMS 10

Two degrees of freedom systems, static and dynamic couplings, Vibration absorbers, Principal co-ordinates, principal modes and orthogonal condition, Eigen value problems, Lagrangian equations and applications.

UNIT III CONTINUOUS SYSTEMS 8

Vibration of elastic bodies, vibration of strings, Longitudinal –lateral and Torsional vibrations.

UNIT IV APPROXIMATE METHODS 9

Approximate methods-Rayleigh's method, Dunkerleys method, Holzer method, Matrix iteration method

UNIT V ELEMENTS OF AEROELASCTICITY 8

Vibrations due to coupling of bending and torsion, collars triangle, aero elastic instabilities and their prevention, Wing divergence, reversal of aileron control, Flutter and its prevention.

TEXTBOOKS:

1. V. P. Singh, "Mechanics of Vibration", (Units 1 to 4)
2. Y.C. Fung, "An Introduction to the Theory of Aeroelasticity", John Wiley & Sons Inc., New York, 2008. (Unit 5)

REFERENCES:

1. Leonard Meirovitch, "Fundamentals of Vibrations", McGraw Hill International Series, 2001
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aeroelasticity – Addison Wesley Publication, New York, 1983.
3. R.H. Scanlan and R.Rosenbaum, "Introduction to the study of Aircraft Vibration and Flutter", Macmillan Co., New York, 1981.
4. R.D.Blevins, "Flow Induced Vibrations", Krieger Pub Co., 2001
5. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.

6. Timoshenko S., Vibration Problems in Engineering – John Wiley and Sons, New York, 1993.

WEBLINKS:
https://swayam.gov.in/course/4531-introduction-to-mechanical-vibration

CO 1	**Compute** the natural frequency of SDOF systems under free and forced vibrations. **(Apply)**
CO 2	**Determine** the frequency of vibrating body using instruments. **(Apply)**
CO 3	**Calculate** principle mode of vibration for MDOF systems. **(Apply)**
CO 4	**Calculate** the natural frequency of continuous systems. **(Apply)**
CO 5	**Calculate** natural frequency of MDOF systems using approximate methods. **(Apply)**
CO 6	**Discuss** the problems in aeroelastic instability and its prevention. **(Understand)**

	AIRCRAFT ENGINE REPAIR AND MAINTENANCE	L	T	P	C
U18PEAE032	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To familiarize with the inspection, overhaul and maintenance of aircraft piston engines and jet engines.					

UNIT I INSPECTION AND TROUBLE SHOOTING OF PISTON ENGINES 9

Need for Inspection, maintenance and trouble shooting in Piston engine – Inspection of all components – Daily and routine checks – Overhaul procedures – Compression testing of cylinders – Special inspection schedules – Engine fuel, control and exhaust systems – Engine mount and super charger – Details of carburetion and injection systems for small and large engines – Ignition system components – Spark plug – Maintenance and inspection check to be carried out.

UNIT II INSPECTION AND TROUBLE SHOOTING OF PROPELLER 9

Propeller theory - operation, construction assembly and installation -Pitch change mechanism-Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions.

UNIT III OVERHAULING OF PISTON ENGINES 9

Symptoms of failure - Fault diagnostics - Case studies of different piston engine systems - Rectification during testing equipments for overhaul: Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance

UNIT IV INSPECTION AND TROUBLE SHOOTING OF GAS TURBINE ENGINES 9

Gas turbine engine inspection & checks – Use of instruments for online maintenance – Maintenance procedures of gas turbine engines – Trouble shooting and rectification procedures – Component maintenance procedures – Systems maintenance procedures. Special inspection procedures: Foreign Object Damage – Blade damage – etc. Gas turbine testing procedures – test schedule preparation – Storage of Engines – Preservation and de-preservation procedures.

UNIT V OVERHAULING OF GAS TURBINE ENGINES 9

Gas turbine Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Balancing of Gas turbine components. Trouble Shooting - Procedures for rectification – Condition monitoring of the engine on ground and at altitude – engine health monitoring and corrective methods.

TEXTBOOKS:

1. Kroes& Wild, “Aircraft Power plants”, 7th Edition – McGraw Hill, New York, 1994.

REFERENCES:

1. Turbomeca, “Gas Turbine Engines”, The English Book Store, New Delhi, 1995.
2. United Technologies Pratt & Whitney, “The Aircraft Gas turbine Engine and its Operation”, The English Book Store, New Delhi.

WEBLINKS:
https://onlinecourses.nptel.ac.in/noc19_ae02

COURSE OUTCOMES	
CO 1	**Describe** the inspection and troubleshooting procedure for piston engine components. **(Understand)**
CO 2	**Explain** the inspection and troubleshooting methods of aircraft propeller. **(Understand)**
CO 3	**Discuss** the overhauling and testing procedure for aircraft reciprocating engine. **(Understand)**
CO 4	**Describe** the checks and maintenance procedures followed in gas turbine engines and **select** appropriate trouble shooting technique. **(Understand)**
CO 5	**Discuss** the overhauling procedure of aircraft gas turbine engine. **(Understand)**

U18PEAE033	MISSILE AERODYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To make the students learn the basics of missile aerodynamics, aerodynamic design and analysis of missile components.

UNIT I BASICS ASPECTS OF MISSILE AERODYNAMICS 9

Classification of missiles-Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles-Missile trajectories-fundamental aspects of hypersonic aerodynamics.

UNIT II MISSILE CONFIGURATIONS AND DRAG ESTIMATION 9

Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT III AERODYNAMICS OF SLENDER AND BLUNT BODIES 9

Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles-determination of aero elastic effects

UNIT IV AERODYNAMIC ASPECTS OF LAUNCHING PHASE 9

Booster separation-cross wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.

UNIT V STABILITY AND CONTROL OF MISSILES 9

Forces and moments acting on missiles-Lateral, rolling and longitudinal moments-missile dispersion-stability aspects of missile configuration-Aerodynamic control methods-Jet control methods-Stability derivatives.

TEXTBOOKS:

1. Nielson, Jack N, Stever, Gutford, “Missile Aerodynamics”, McGraw Hill, New York,1960.

REFERENCES:

1. Anderson, J.D., “Hypersonic and High Temperature Gas Dynamics”, AIAA Education Series.
2. Chin SS, “Missile Configuration Design”, McGraw Hill, New York, 1961.
3. Micheal J Hemsch, “Tactical Missile Aerodynamics”, Progress in Aeronautics and Astronautics, AIAA, 1992.

WEBLINKS:

https://searchworks.stanford.edu/view/8798442

COURSE OUTCOMES	
CO 1	**Describe** the classification of missiles (**Understand**)
CO 2	**Estimate** the Aerodynamic forces on missiles. (**Apply**)
CO 3	**Describe** the Aerodynamic characteristics methods of missiles. **(Understand)**
CO 4	**Describe** the aerodynamic aspects of launching phase. **(Understand)**
CO 5	Describe the stability characteristics of missiles. **(Understand)**

U18PEAE034	HYPERSONIC AERODYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Gas Dynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To study the environment around hypersonic vehicles and bodies created by strong shock waves.

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight paths – hypersonic similarity parameters-shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS 9

Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self similar boundary layers-solution methods for non self similar boundary layers aerodynamic heating.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions.

UNIT V INTRODUCTION TO HIGH TEMPERATURE EFFECTS 9

Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

TEXTBOOKS:

1. Ethirajan Rathakrishnan., "High Enthalpy Gas Dynamics", John Wiley and Sons, 2015

REFERENCES:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA Series, New York, 2006.
2. John. D. Anderson. Jr., "Modern compressible flow with historical perspective", McGraw Hill Publishing Company, New York, 1996.
3. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc.,Washington. D.C., 1994.

WEBLINKS:

https://nptel.ac.in/courses/101103003/

COURSE OUTCOMES	
CO 1	**Recall** the concepts of compressible flows and differentiate between supersonic and hypersonic flows. **(Remember)**
CO 2	**Discuss** simple solution methods of hypersonic inviscid flows. **(Understand)**
CO 3	**Discuss** the basics of viscous hypersonic flows. **(Understand)**
CO 4	**Describe** the shock shear layer interaction in hypersonic flows. **(Understand)**
CO 5	**Discuss** basics of high temperature flows. **(Understand)**

OPTIONS FOR PROFESSIONAL ELECTIVE (PE) IV

U18PEAE041	**AN INTRODUCTION TO COMBUSTION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Aero – Thermodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with the basics of combustion in aircraft and rocket engines.					

UNIT I INTRODUCTION TO COMBUSTION 9

Thermochemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – Stoichiometric ratio, equivalence ratio – measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES 9

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE ENGINES 9

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, fuels used for gas turbine combustion chambers – combustion stability – ramjet combustion – differences between the design of ramjet combustion chambers and gas turbine combustion chambers- flame holders types – numerical problems.

UNIT IV COMBUSTION IN SCRAMJET ENGINES 9

Introduction to supersonic combustion – need for supersonic combustion for hypersonic air-breathing propulsion- supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors.

UNIT V COMBUSTION IN ROCKET ENGINES 9

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion hybrid rockets

TEXTBOOKS:

1. Stephen R turns, ”An Introduction to Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, Reprint 2013. (Units 1 & 2)
2. Lefebvre AG and Dilip R ballal, “Gas Turbine Combustion”, CRC press, Third Edition, 2010. (Unit 3)
3. Corin Segal, “The Scramjet engine”, Cambridge University Press, 2009 (Unit 4)
4. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 7th Edition, 2001 (Unit 5)

REFERENCES:

1. Warnatz J, Maas U and Dibble RW, ”Combustion”, Springer, Fourth Edition,2006.
2. Beer, J.M., and Chiger, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
3. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987

WEBLINKS:
https://swayam.gov.in/course/4339-fundamentals-of-combustion-i

COURSE OUTCOMES	
CO 1	**Explain** thermo chemical reaction associated with combustion process and the various parameters affecting burning velocity. **(Understand)**
CO 2	**Select** apt fuel for optimum combustion in piston engines. **(Analyze)**
CO 3	**Compare** the ramjet and gas turbine combustion chamber design. **(Understand)**
CO 4	**Analyze** the challenges associated with supersonic combustion.**(Analyze)**
CO 5	**Discuss** combustion process in solid, liquid propellant rockets and hybrid rockets. **(Understand)**

U18PEAE042	NANO SCIENCE AND TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint about the applications and significance of nanomaterials in aerospace engineering.

UNIT I INTRODUCTION 9

Introduction to nanoscale materials - atomic & molecular size. Scientific revolutions-nanotechnology application area. Scope of nanoscience and technology

UNIT II NANOSTRUCTURES AND DIMENSIONS 9

Classification of nanostructures-zero, one, two and three dimensional nanostructures. Size Dependency in Nanostructures-quantum size effects in nanostructures.

UNIT III NANOMATERIAL SYNTHESIS 9

Synthesis of nanomaterials-top down and bottom up approach. Method of nanomaterials preparation – wet chemical synthesis-mechanical grinding-gas phase synthesis.

UNIT IV NANOMATERIAL PROPERTIES 9

Surface to volume ratio. Surface properties of nanoparticles. Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra.Shape impact.

UNIT V PHYSICAL PROPERTIES OF NANOSTRUCTURED MATERIALS 9

Quantum dots-optical properties and applications. Carbon nanotubes-physical properties and applications. Magnetic behavior of nanomaterials. Electronic transport in quantum wires.

TEXTBOOKS:

1. T. Pradeep, “Nano the Essential Nanoscience and Nanotechnology”, Tata McGraw hill, 2007.

REFERENCES:

1. Charles P. Poole, Frank J. Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.
2. Mark A. Ratner, Daniel Ratner, “Nanotechnology: A gentle introduction to the next Big Idea”, Prentice Hall P7R:1st Edition, 2002.
3. J. Dutta, H. Hoffmann, “Nanomaterials”, Topnano-21, 2003.
4. Mick Wilson, KamaliKannargare., Geoff Smith, “Nano technology: Basic Science and Emerging technologies”, Overseas Press, 2005.

WEBLINKS:

https://www.edx.org/learn/nanotechnology

COURSE OUTCOMES	
CO 1	**Memorize** the fundamentals of nanoscale materials and the scope of nanoscience and technology. **(Remember)**
CO 2	**Describe** the types of nanostructures and quantum size effects in nanostructures. **(Understand)**

CO 3	**Discuss** the synthesis of nanomaterials and methods of nanomaterials preparation. **(Understand)**
CO 4	**Define** the Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. **(Understand)**
CO 5	**List** the physical properties of nanostructured materials. **(Apply)**

U18PEAE043	AIRPORT ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint about the systems, processes, standards in airport engineering.					

UNIT I INTRODUCTION 9

History, development, policy of air transport, Advantages and limitations of air transportation, aircrafts, aerodromes, air transport authorities, air transport activities, aircraft and its characteristics, airport classifications as per ICAO.

UNIT II AIRPORT PLANNING 9

Regional planning-concepts and advantages, location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements -airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity, airport size and site selection, estimation of future air traffic, development of new airport, requirements of an ideal airport layout.

UNIT III RUN WAY DESIGN 9

Wind rose and orientation of runway, wind coverage and crosswind component, factors affecting runway length, basic runway length, and corrections to runway length, runway geometrics and runway patterns (configurations). Runway marking.

UNIT IV TAXI WAY DESIGN 9

Controlling factors, taxiway geometric elements, layout, exit taxiway, location and geometrics, holding apron, turnaround facility. Aprons -locations, size, gate positions, aircraft parking configurations and parking systems, hangar-site selection, planning and design considerations, Fuel storage area, blast pads, wind direction indicator

UNIT V AIR TRAFFIC CONTROL AND TERMINAL DESIGN 9

Air traffic control-objectives, control system, control network-visual aids-landing information system, airport markings and lighting. Terminal area elements and requirements, terminal building functions, space requirements, location planning concepts, vehicular parking area and circulation network, passenger requirements at terminal building

TEXTBOOKS:

1. Airport Engineering - Rangawala, Charotar publishing House, Anand 388001 (Gujrat).

REFERENCES:

1. Horonjeff and F X Mckelvy, Planning and design of Airport, Mc-Graw Hill International Editions, 1993.
2. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi.
3. "Airport Engineering: Planning and Design" by S C Saxena.
4. Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee.

WEBLINKS:

https://www.iata.org/training/courses/Pages/airport-operations-tapp14.aspx

COURSE OUTCOMES	
CO 1	**State** the Role of ICAO and IATA and to D**efine** the airline management and organization. **(Remember)**

CO 2	**Describe** aircraft forecasting and fleet planning and to do route analysis. **(Understand)**
CO 3	**Summarize** the flight operations and various methods of flight scheduling. **(Understand)**
CO 4	**Discuss** the condition monitoring maintenance and ageing aircraft maintenance production. **(Understand)**
CO 5	**List** the equipment and tools for aircraft maintenance. **(Apply)**

U18PEAE044	THEORY OF PLATES AND SHELLS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

To acquaint about the classic plate theory, method of analysis various shapes and concept of shell.

UNIT I CLASSICAL PLATE THEORY 9

Classical Plate Theory – Assumptions – Differential Equations – Boundary Conditions – Axi-Symmetric Loading.

UNIT II PLATES OF VARIOUS SHAPES **9**

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions – Annular Plates – Plates of other shapes.

UNIT III EIGEN VALUE ANALYSIS **9**

Stability and Free Vibration Analysis of Rectangular Plates.

UNIT IV APPROXIMATE METHODS **9**

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT V SHELLS **9**

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

TEXT BOOKS:

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. Varadhan. T. K. &Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

REFERENCES:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw Hill Book Co.1986.
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Llyod Hamilton, Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. Ansel Ugural, Stresses in Plates & Shells, McGraw Hill, 1981
6. Reddy.J.N., "Theory & Analysis of Elastic Plates", CRC, I Edition, 1999

COURSE OUTCOMES	
CO 1	**Explain** the classical plate theory subjected to Axi-symmetric loading. **(Understand)**
CO 2	**Use** Navier's method and Levy's method to obtain solution for rectangular plates under different boundary conditions. **(Apply)**
CO 3	**Illustrate** the stability and free vibration analysis of rectangular plates. **(Understand)**
CO 4	**Apply** various approximate methods on rectangular plates for stability analysis. **(Apply)**
CO 5	**Describe** the concepts of shell type structures and bending theories for circular cylindrical shells. **(Understand)**

ELECTIVE (PE) V

U18PCAE051	**COMPOSITE MATERIALS AND STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Mechanics and Machines, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce the student about significance of composite materials, and their design and analysis using different approaches.					

UNIT I INTRODUCTION TO COMPOSITES AND MICROMECHANICS 10

Introduction – advantages, limitations and application of composite materials – types of reinforcements and matrices, natural fibers and fillers - micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites – effectof voids in composites.

UNIT II MACROMECHANICS 10

Generalized Hooke's Law - elastic constants for anisotropic, orthotropic and isotropic materials -macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination ofin plane strengths of a lamina - experimental characterization of lamina – failure theories of a lamina – hygrothermal effects on lamina.

UNIT III LAMINATE THEORY 10

Governing differential equation for a laminate, stress – strain relations for a laminate, different types of laminates, in plane and flexural constants of a laminate, hygrothermal stresses and strains in a laminate, failure analysis of a laminate, impact resistance and interlaminar stresses, netting analysis

UNIT IV FABRICATION AND REPAIR OF COMPOSITES 8

Various open and closed mould processes, manufacture of fibers, importance of repair and differenttypes of repair techniques in composites – autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTION 7

Basic design concepts of sandwich construction - materials used for sandwich construction – failure modes of sandwich panels - bending stress and shear flow in composite beams.

TEXTBOOKS:

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2005.

REFERENCES:

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
4. MadhujiMukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004
5. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, II Edition, 1999.

WEBLINKS:

https://online.stanford.edu/courses/aa256-mechanics-composites

COURSE OUTCOMES	
CO 1	**Discuss** the advantages of composites and the manufacturing of fiber-reinforced composites **(Remember).**
CO 2	**Develop** the mechanics of fiber-reinforced composites based on generalized classical theory of elasticity **(Apply).**
CO 3	**List** structural characterization method for composites in tension and bending modes and **describe** the failure theories of composites **(Apply).**
CO 4	**Discuss** fabrication and repair procedures used for composite components**(Understand).**
CO 5	**Develop** structural mechanics of composite beams and **describe** design of sandwich beam **(Apply).**

	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
U18PEAE052	Prerequisite – Fundamentals of Mechanics and Machines, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE:

To make the student understand on experimental method of finding the response of the structure to different types of load.

UNIT I MEASUREMENTS AND EXTENSOMETERS 9

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 9

Principle of operation and requirements, Types and their uses, Materials for strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT III PHOTOELASTICITY 9

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission and Reflection polariscopes, Interpretation of fringe pattern, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE METHODS 9

Introduction to Moiré techniques, Brittle coating methods and Holography

UNIT V NON – DESTRUCTIVE TESTING 9

Fundamentals of NDT, Radiography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing, Acoustic Emission Technique

TEXTBOOKS:

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, 2009.

REFERENCES:

1. Hetenyi, M., “Hand book of Experimental Stress Analysis”, John Wiley and Sons Inc., New York, 1972.
2. Max Mark Frocht,” Photo Elasticity”, John Wiley and Sons Inc., New York, 1968
3. A.J.Durelli, “Applied Stress Analysis”, Prentice Hall of India Pvt Ltd., New Delhi, 1970
4. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., “Experimental Stress Analysis”, Tata McGraw Hill, New Delhi, 1984.
5. James F. Doyle ,”Modern Experimental Stress Analysis “,John Wiley & Sons, 2004.
6. Ramesh, K., ” Experimental Stress Analysis”, Indian Institute of Technology Madras, India,E-book,2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_me39/preview

COURSE OUTCOMES	
CO 1	**Describe** the working principle of different extensometers and their uses. **(Understand)**
CO 2	**Compute** the strain in loaded structures based on measurement of change in resistance using strain gauges. (**Apply**)
CO 3	**Discuss** the techniques used for determination of stress in photo elastic materials. **(Understand)**
CO 4	**Explain** the concepts of more technique and brittle coating techniques. **(Understand)**
CO 5	**Summarize** the fundamentals of NDT and **Describe** the different type of NDT methods. **(Understand)**

U18PEAE053	HELICOPTER MAINTENANCE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aircraft Systems and Instrumentation				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the student with the fundamentals of helicopter components, functions and their maintenance.

UNIT I HELICOPTER FUNDAMENTALS 6

Basic components of helicopters and working – Ground handling, bearing – Gears.

UNIT II MAINTENANCE OF MAIN ROTOR SYSTEM 12

Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.

UNIT III MAINTENANCE OF MAIN ROTOR TRANSMISSION 12

Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.

UNIT IV MAINTENANCE OF POWERLANT AND TAIL ROTOR 9

Fixed wing power plant modifications – Installation – Different type of power plant maintenance. Tail rotor system – Servicing tail rotor track – System rigging.

UNIT V AIRFRAME AND RELATED SYSTEMS 6

Fuselage maintenance – Airframe Systems – Special purpose equipment.

TEXTBOOKS:

1. Jeppesen, “Helicopter Maintenance”, Jeppesens and Sons Inc., 2000.

REFERENCES:

1. “Civil Aircraft Inspection Procedures”, Part I and II, CAA, English Book House, New Delhi, 1998.
2. Larry Reithmier, “Aircraft Repair Manual”, Palamar Books Marquette, 1992.

WEBLINKS:

http://www.aviationmaintenance.edu/programs/

COURSE OUTCOMES	
CO 1	**Explain** the basic components and working of helicopter. **(Understand)**
CO 2	**Explain** the balancing of main rotor and **Discuss** the maintenance procedures in control rigging. **(Understand)**
CO 3	**Discuss** the main rotor transmission coupling and maintenance steps involved. **(Understand)**
CO 4	**Discuss** installation and modification of fixed wing power plant. **(Understand)**
CO 5	**Describe** maintenance procedure of power plant and tail rotor system. **(Understand)**
CO 6	**Explain** the maintenance procedures involved in fuselage and airframe systems. **(Understand)**

	HEAT TRANSFER IN AEROSPACE APPLICATIONS	L	T	P	C
U18PEAE054	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Aero – Thermodynamics, Fluid Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To familiarize the student with the various modes of heat transfer, estimation of heat transfer parameters and design of heat transfer devices, insulators and heat shields.

(Use of Heat and Mass Transfer Data Book is permitted)

UNIT I CONDUCTION HEAT TRANSFER – STEADY STATE 7

Modes of heat transfer: One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces.

UNIT II CONDUCTION HEAT TRANSFER – TRANSIENT 10

Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Transient Heat Transfer – Temperature charts

UNIT III CONVECTIVE HEAT TRANSFER 8

Introduction – Free convection in atmosphere - free convection on a vertical flat plate – Empirical relation in free convection – Forced convection – Laminar and turbulent - convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations.

UNIT IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS 10

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces – Radiation between surfaces-Radiation shape factors-Radiation shields.

Types of heat exchangers -overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 10

Heat transfer problems in gas turbine engines, rocket nozzles and re-entry vehicles – Numerical techniques to solve heat transfer problems in aerospace engineering –numerical problems using software and programming.

TEXTBOOKS:

1. Sachdeva, S.C. “Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd. Fourth Edition, New Delhi, 2012. (Units 1 to 4)
2. Sunden B, Juan Fu, “Heat Transfer in Aerospace Applications”, Academic Press, First Edition, 2016 (Unit 5)

REFERENCES:

1. Sutton, G.P., "Rocket Propulsion Elements ", John Wiley and Sons, 8th Edition.2010.
2. Lienhard J. H., “A Heat Transfer Text Book”, Phlogiston Press, U.S.A., 2008.
3. Ozisik M.N., “Heat Transfer A Basic Approach”, The McGraw-Hill Company, reprint 1995.
4. Holman, J.P., "Heat Transfer ", McGraw Hill Book Co., Inc., New York, TenthEdition.,2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_ch08/course

COURSE OUTCOMES	
CO 1	**Solve** one dimensional steady state heat conduction problems. (**Apply**)
CO 2	**Estimate** heat transfer rate ofsemi-infinite and infinite solids. (**Evaluate**)
CO 3	**Estimate** heat transfer coefficient for flow over a flat plate and circular pipe. (**Evaluate**)
CO 4	**Calculate** radiative heat transfer of black and gray surfaces. (**Apply**)
CO 5	**Compare** different types of heat exchangers and Evaluate their performance. (**Analyze**)
CO 6	**Solve** heat transfer problems related to aerospace applications. (**Apply**)

PROFESSIONAL ELECTIVE (PE) VI

U18PEAE061	**HIGH TEMPERATURE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with the fundamentals of creep, hot corrosion, fracture mechanisms under high temperature and alloys for high temperature applications.					

UNIT I INTRODUCTION TO HIGH TEMPERATURE MATERIALS 6

Components exposed to high temperatures, significance of high temperature materials, recent trends in high temperature material research

UNIT II CREEP AND DESIGN FOR CREEP RESISTANCE 12

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate. Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE 9

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, and ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT IV OXIDATION AND HOT CORROSION 9

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPER ALLOYS AND OTHER MATERIALS 9

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

TEXTBOOKS:

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985. (Units 1, 2, 3 & 5)
2. David J. Young, "High Temperature Oxidation and Corrosion of Metals", Second Edition, Elsevier Science Ltd., 2016 (Unit 4)

REFERENCES:

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.
4. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
5. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

WEBLINKS:
https://nptel.ac.in/courses/113105019/

COURSE OUTCOMES	
CO 1	**Discuss** the effect of creep on the functional life of components. **(Understand)**
CO 2	**Explain** the creep resistance of ductile and brittle materials. **(Understand)**
CO 3	**Describe** the effect of different alloys and oxidesmaterials behaviour from low temperature to high temperature **. (Understand)**
CO 4	**Discuss** the fracture mechanism maps for different alloys and oxides**. (Understand)**
CO 5	**Describe** the process of oxidation and different oxidations prevention techniques. **(Understand)**
CO 6	**Discuss** the various types of super alloys and its strengthening mechanisms. **(Understand)**

U18PEAE062	FATIGUE AND FRACTURE MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enable the student to understand the basic concepts of fatigue and fracture, processes, statistical tools for fatigue life prediction, realizing importance of fatigue and fracture in aerospace industry.

UNIT I FATIGUE OF STRUCTURES 9

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 9

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory - Other theories.

UNIT III PHYSICAL ASPECTS OF FATIGUE 9

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS 9

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Irwin extension of Griffith's theory to ductile materials - stress analysis of "cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT V FATIGUE DESIGN AND TESTINIG 9

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TEXTBOOKS:

1. Matej Billy, "Cyclic Deformation and Fatigue of Metals", Elsevier Science Ltd., 1993. (Units 1 to 3)
2. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009. (Unit 4)
3. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pergamon press. Oxford, 1983 (Unit 5)

REFERENCES:

1. K. R.Y. Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited, 2001
2. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
3. T.L. Anderson, Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005

WEBLINKS:

https://ocw.mit.edu/courses/materials-science-and-engineering/3-35-fracture-and-fatigue-fall-2003/

COURSE OUTCOMES	
CO 1	**Calculate** the stress concentration in structures subjected to fatigue loads. (**Analyze**)
CO 2	**Describe** statistical methods to determine the strain in structures under fatigue loading. (**Understand**)
CO 3	**Describe** various stages of failures due to fatigue load. (**Understand**)
CO 4	**Determine** stress in cracked structures. (**Apply**)
CO 5	**Design** composite material-based structures subjected to fatigue load which are fail-safe. **(Create)**

	CRYOGENIC ROCKET PROPULSION	L	T	P	C
U18PEAE063	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce to the student the basics of cryogenic systems and associated processes and cryogenic rocket technology.					

UNIT I INTRODUCTION TO CRYOGENIC SYSTEMS 9

Cryogenic systems and basic components, Properties of Cryogenic fluids, Liquefaction systems, ideal, Cascade, Linde Hampson and Claude cycles and their derivatives; Refrigerators: Stirling, Gifford-McMahon cycles and their derivatives. Cryogenic Insulations: Foam, Fibre, powder and Multilayer.

UNIT II CRYO FUEL SYSTEMS 9

Cryogenic and semi – cryogenic propellants - Hydrogen - properties, and pretreatment - Liquefaction of hydrogen - Linde, Claude and helium - hydrogen condensing cycles, Ortho-para conversion. Storage and handling of liquefied hydrogen

UNIT III CRYO EQUIPMENT AND ACCESSORIES 9

Mechanical and Thermal Properties of engineering materials at low temperatures; Compressors: types, construction and characteristics; Expansion machines: characteristics of reciprocating and turbine expanders, design of J-T expander; Heat exchangers: types, design approaches and selection criteria, Design of cryogenic storage vessels, transfer devices, insulation system, valves; Characteristics of cryogenic pumps, Instrumentation in cryogenic systems

UNIT IV CRYOGENIC ENGINES 9

Fluid circuits of various cryogenic engines and semi-cryogenic engines; Design of regeneratively cooled combustion chamber, film cooling, dump cooling, transpiration cooling and radiation cooling. Design of expansion nozzle- characteristics, Design of injector–hydraulic characteristics; Engine thrust and mixture ratio control, Igniters, Propellant tanks.

UNIT V CHALLENGES IN CRYOGENIC ROCKET TECHNOLOGY 9

Problems in storage and handling of cryogenic propellants: safety aspects, Thermal protection systems for stage tanks, Thermal stratification- destratification, Geysering effect – geysering elemination, Zero “g” problems – restart mechanism.

TEXTBOOKS:

1. “A text book of Cryogenics”, “Valery V. Kostionk”, Discovery Publishing House, 2010. (Units 1 to 3)
2. “Operation of a Cryogenic Rocket Engine”, “Kitsche, Wolfgang”, Springer Publications, 2011. (Units 4 & 5)

REFERENCES:

1. “Rocket Propulsion Elements”, “Sutton G. P., Bibliarz”

WEBLINKS:

https://nptel.ac.in/courses/112101004/

COURSE OUTCOMES	
CO 1	**Discuss** the basic components of cryogenic systems. **(Understand)**
CO 2	**Explain** the types of cryogenic propellant used and their storage and handling. **(Understand)**
CO 3	**Discuss** cryo equipment and accessories of cryogenic engine system. **(Understand)**
CO 4	**Discuss** various subsystem involved in the operation of cryogenic engine and their design aspects. **(Understand)**
CO 5	**Discuss** the challenges in cryogenic rocket technology. **(Understand)**

U18PEAE064	STRUCTURAL DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To study the effect of periodic and a periodic forces on mechanical systems with matrix approach and also to get the natural characteristics of large sized problems using approximate methods.

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

Constraints and Generalized coordinates-Virtual work and generalized forces- Force-Deflection influence functions-stiffness and flexibility methods.

UNIT II PRINCIPLES OF DYNAMICS 9

Free and forced vibrations of systems with finite degrees of freedom-Damped oscillations-D" Alembert's principle-Hamilton's principle-Lagrangean equations of motion and applications.

UNIT III NATURAL MODES OF VIBRATION 9

Equations of motion for Multi degree of freedom Systems - Solution of Eigen value problems – Normal coordinates and orthogonality Conditions. Modal Analysis.

UNIT IV ENERGY METHODS 9

Rayleigh's principle-Rayleigh-Ritz method-Coupled natural modes-Effect of rotary inertia and shear on lateral vibrations of beams-Natural vibrations of plates.

UNIT V APPROXIMATE METHODS 9

Approximate methods of evaluating the Eigen values and the dynamic response of continuous systems. Application of Matrix methods for dynamic analysis.

TEXTBOOKS:

1. F. S. Tse, I. E. Morse and H. T. Hinkle, "Mechanical Vibration", Prentice Hall of India Pvt. Ltd, NeW Delhi, 1988.
2. W. C. Hurty and M. F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd, New Delhi, 1987.

REFERENCES:

1. R. K. Vierck, "Vibration Analysis" 2nd Edition, Thomas Y. Crowell & Co Harper &Row Publishers, New York, U.S.A. 1989.
2. S. P. Timoshnko ad D. H. Young, "Vinration Problems in Engineering", John Willey & Sons Inc., 1984.
3. von Karman and A. Biot, "Mathematical Methods in Engineering", McGraw-Hill Book Co.,New York, 1985.
4. Ramamurthi. V., "Mechanical Vibration Practice and Noise Control" Narosa Publishing House Pvt. Ltd, 2008

COURSE OUTCOMES	
CO 1	**Review**stiffness and flexibility method of structural analysis (**Understand)**
CO 2	**Describe** the significance of dynamic loadingand **solve** forced vibrations of finite degree of freedom systems (**Apply**).
CO 3	**Explain** modal analysis of multiple degree of freedom systems (**Analyze**).
CO 4	**Apply** energy methodsto solve beam and plate vibrations problems under dynamics loads (**Apply**).
CO 5	**Evaluate**dynamic response of continuous systems using approximate methods (**Analyze**)

CURRICULUM AND SYLLABUS

(R2018)

B – FACT: (Bharath – **F**lexible **A**ccommodative **C**hoice based credit system for **T**echnology)

(Applicable to the batches admitted from July 2018)

B.Tech - AEROSPACE ENGINEERING

FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	3	3	0	0	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	2	0	0	2	0
8	*U18BSCH2L4	BS	Chemistry Lab	2	0	0	2	0
9	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	U18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
TOTAL				**31**	**18**	**1**	**12**	**21**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	3	0	0	3
2	U18BSMA201	BS	Engineering Mathematics- II	4	3	1	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	4	0	0	4	2
8	*U18BSCH2L4	BS	Chemistry Lab	4	0	0	4	2
9	U18ESME1L2	ES	Workshop / Manufacturing Practices Laboratory	3	3	0	0	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
TOTAL				**37**	**20**	**1**	**16**	**27**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA302	BS	Partial Differential Equations, Probability and Statistics	4	3	1	0	4
2	U18PCAS301	PC	Introduction to Aerospace Engineering	2	2	0	0	2
3	U18PCAS302	PC	Applied Dynamics and Vibration	3	3	0	0	3
4	U18ESAS301	ES	Fundamentals of Fluid Mechanics	3	3	0	0	3
5	U18ESAS302	ES	Fundamentals of Aero – Thermodynamics	3	3	0	0	3
6	U18ESAS303	ES	Fundamentals of Structural Mechanics	3	3	0	0	3
PRACTICAL								
7	U18PCAS3L1	PC	Strength of Materials Laboratory	4	0	0	4	2
8	U18PCAS3L2	PC	Computer Aided Design and Drafting Laboratory	4	0	0	4	2
9	U18ESAS3L1	ES	Fluid Mechanics and Machinery Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
TOTAL				**34**	**17**	**01**	**16**	**24**

SEMESTER IV								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA401	BS	Numerical Methods	3	3	1	0	4
2	U18PCAS401	PC	Elements of Aerospace Structures	3	3	0	0	3
3	U18PCAS402	PC	Aerodynamics	3	3	0	0	3
4	U18PCAS403	PC	Air breathing Propulsion	3	3	0	0	3

5	U18PCAS404	PC	Aerospace Materials	2	2	0	0	2
6	U18PCAS405	PC	Manufacturing Technology	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	0	0	2	0
PRACTICAL								
8	U18PCAS4L1	PC	Aerodynamics Laboratory	4	0	0	4	2
9	U18PCAS4L2	PC	Manufacturing Technology Laboratory	4	0	0	4	2
10	U18PCAS4L3	PC	Introduction to MATLAB	4	0	0	4	2
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
TOTAL				**35**	**17**	**01**	**18**	**24**

SEMESTER V								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAS501	PC	Aerospace Structural Mechanics	3	3	0	0	3
2	U18PCAS502	PC	Compressible Flow	3	3	0	0	3
3	U18PCAS503	PC	Rocket Propulsion	3	3	0	0	3
4	U18PCAE504	PC	Aircraft Performance	3	3	0	0	3
5	U18PCAS505	PC	Aircraft Stability and Control	3	3	0	0	3
6	U18PEAS5E1	PE	Professional Elective – I	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	0	0	2	0
PRACTICAL								
8	U18PCAE5L1	PC	Aircraft Structures Laboratory	4	0	0	4	2
9	U18PCAS5L2	PC	Gas Dynamics Laboratory	4	0	0	4	2
10	U18PCAE5L3	PC	Flight Simulation Laboratory	4	0	0	4	2
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0

12	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
TOTAL				**36**	**18**	**0**	**18**	**24**

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSBA601	HS	Organizational Behavior for Engineers	3	3	0	0	3
2	U18PCAE601	PC	Finite Element Analysis	3	3	0	0	3
3	U18PCAS602	PC	Heat Transfer	3	3	0	0	3
4	U18PEAS6E2	PE	Professional Elective – II	3	3	0	0	3
5	U18OEAS6E1	OE	Open Elective – I	3	3	0	0	3
6	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	0	0	2	0
PRACTICAL								
7	U18PCAS6L1	PC	Computer Aided Analysis Laboratory	4	0	0	4	2
8	U18PCAS6L2	PC	Propulsion Laboratory	4	0	0	4	2
9	U18EEAS6L1	EE	Aircraft Design Project	6	0	0	6	3
ACTIVITY BASED COURSES								
10	U18MCAB609	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB610	MC	Social Services – NSS	2	0	0	2	0
TOTAL				**35**	**15**	**0**	**20**	**22**

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAS701	PC	Guidance and Control	3	3	0	0	3
2	U18PCAS702	PC	Satellite Technology	3	3	0	0	3
3	U18PEAS7E3	PE	Professional Elective – III	3	3	0	0	3
4	U18PEAS7E4	PE	Professional Elective – IV	3	3	0	0	3
5	U18PEAS7E5	PE	Professional Elective – V	3	3	0	0	3
6	U18OEAS7E2	OE	Open Elective – II	3	3	0	0	3
PRACTICAL								
7	U18PCAS7L1	PC	Satellite Design Laboratory	4	0	0	4	2
8	U18PRAS7P1	PR	Project Phase I	3	3	0	0	3

ACTIVITY BASED COURSES								
9	U18MCAB713	MC	Behavioral and Interpersonal Skills	2	0	0	2	0
10	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
TOTAL				**29**	**21**	**0**	**8**	**23**

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PEAS8E6	PE	Professional Elective – VI	3	3	0	0	3
	U18OEAS8E3	OE	Open Elective – III (MOOC)	0	0	0	0	2
2	U180EAS8E4	OE	Open Elective – IV	3	3	0	0	3
PRACTICAL								
3	U18PRAS8P2	PR	Project Phase II	18	0	0	18	9
4	U18EEAS8C1	EE	Comprehension	0	0	0	0	1
ACTIVITY BASED COURSES								
5	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL				**26**	**06**	**0**	**20**	**18**

Total No. of Contact Hours : 263 Hours

Total No. of Credits :183

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

Sl. No.	Category of Courses	Semester wise Credits								No. of Credits	% of Credits
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences (HS)	3	3	-	-	-	3	-	-	09	5
2	Basic Sciences (BS)	10	16	4	4	-	-	-	-	34	18.5
3	Engineering Sciences (ES)	8	8	11	-	-	-	-	-	27	14.75
4	Professional Core (PC)	-	-	9	20	21	10	8	-	68	37.15
5	Professional Electives (PE)	-	-	-	-	3	3	9	3	18	9.8
6	Open Electives (OE)	-	-	-	-	-	3	3	5	11	6
7	Employability Enhancement (EE) Such as Technical Seminar, Internship, Term Paper etc.	-	-	-	-	-	3		1	4	2
8	Project Work, (PR),							3	9	12	6.5
8	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	-	-
Total Credit		21	27	24	24	24	22	23	18	183	100
Total Contact Hours		31	37	34	35	36	35	29	26	263 Hours	

LIST OF ELECTIVES

List of Professional Elective(PE) I:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAS011	Aerospace	Space Mission Design and Analysis	3	0	0	3
U18PEAS012	Aerospace	Systems Engineering	3	0	0	3
U18PEAS013	Aerodynamics	Launch Vehicle Aerodynamics	3	0	0	3
U18PEAS014	Aerodynamics	Boundary Layer Theory	3	0	0	3

List of Professional Elective (PE)II:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAS021	Structures	Theory of Elasticity	3	0	0	3
U18PEAS022	Aerospace	Manned Space Missions	3	0	0	3
U18PEAS023	Propulsion	Electric Propulsion	3	0	0	3
U18PEAS024	Propulsion	Spacecraft Power Systems	3	0	0	3

List of Professional Elective (PE) III:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAE031	Aerodynamics	Hypersonic Aerodynamics	3	0	0	3
U18PEAS032	Structures	Vibrations and Elements of Aero elasticity	3	0	0	3
U18PEAS033	Aerospace	Space Vehicle Design	3	0	0	3
U18PEAS034	Renewable Energy	Solar Thermal Energy	3	0	0	3

List of Professional Elective (PE) IV:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAS041	Propulsion	An Introduction to Combustion	3	0	0	3
U18PEAS042	Structures	Theory of Plate and shell	3	0	0	3
U18PEAS043	Aerospace	Spacecraft Attitude Dynamics and Control	3	0	0	3
U18PEAS044	Aerodynamics	High Temperature Gas Dynamics	3	0	0	3

List of Professional Elective (PE) V:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAS051	Aerospace	Space Flight Mechanics	3	0	0	3
U18PEAS052	Structures	Experimental Stress Analysis	3	0	0	3
U18PEAS053	Avionics	Automatic Control	3	0	0	3
U18PEAS054	Aerodynamics	Computational Fluid Dynamics	3	0	0	3

List of Professional Elective (PE) VI:

Code No.	Specialization	Course Title	L	T	P	C
U18PEAS061	Propulsion	Cryogenic Rocket Propulsion	3	0	0	3
U18PEAS062	Materials science	High Temperature Materials	3	0	0	3
U18PEAS063	structures	Structural Dynamics	3	0	0	3
U18PEAS064	Aerospace	High Temperature Problems In Aerospace Structures	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance

43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS001-Mobile Application Development
72. U18OECS002-System Modelling and Simulation
73. U18OECS003-Web Programming
74. U18OECS004-Virtual Reality
75. U18OECS005- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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LIST OF COURSES UNDER HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT STUDIES (HS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	HS	Communicative English	3	3	0	0	3
2	U18HSEN201	HS	Technical English	3	3	0	0	3
3	U18HSBA601	HS	Organizational Behavior for Engineers	3	3	0	0	3
TOTAL				9	9	0	0	9

LIST OF COURSES UNDER BASIC SCIENCE COURSES (BS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	U18BSMA201	BS	Engineering Mathematics- II	4	3	1	0	4
5	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
6	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
7	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
8	U18BSMA302	BS	Partial Differential Equations, Probability and Statistics	4	3	1	0	4
9	U18BSMA401	BS	Numerical Methods	3	3	1	0	4
PRACTICAL								
10	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	4	0	0	4	2
11	*U18BSCH2L4	BS	Chemistry Lab	4	0	0	4	2
TOTAL				37	26	4	8	34

LIST OF COURSES UNDER ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	3	3	0	0	3
3	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
4	U18ESAS301	ES	Fundamentals of Fluid Mechanics	3	3	0	0	3
5	U18ESAS302	ES	Fundamentals of Aero – Thermodynamics	3	3	0	0	3
6	U18ESAS303	ES	Fundamentals of Structural Mechanics	3	3	0	0	3
PRACTICAL								
7	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	4	0	0	4	2
8	U18ESME1L2	ES	Workshop / Manufacturing Practices Laboratory	3	3	0	0	3
9	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Laboratory	4	0	0	4	2
10	U18ESAS3L1	ES	Fluid Mechanics and Machinery Laboratory	4	0	0	4	2
TOTAL				**33**	21	0	12	27

LIST OF COURSES UNDER PROFESSIONAL CORE COURSES (PC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCAS301	PC	Introduction to Aerospace Engineering	2	2	0	0	2
2	U18PCAS302	PC	Applied Dynamics and	3	3	0	0	3

			Vibration					
3	U18PCAS401	PC	Elements of Aerospace Structures	3	3	0	0	3
4	U18PCAS402	PC	Aerodynamics	3	3	0	0	3
5	U18PCAS403	PC	Air breathing Propulsion	3	3	0	0	3
6	U18PCAS404	PC	Aerospace Materials	2	2	0	0	2
7	U18PCAS405	PC	Manufacturing Technology	2	2	0	0	2
8	U18PCAS501	PC	Aerospace Structural Mechanics	3	3	0	0	3
9	U18PCAS502	PC	Compressible Flow	3	3	0	0	3
10	U18PCAS503	PC	Rocket Propulsion	3	3	0	0	3
11	U18PCAE504	PC	Aircraft Performance	3	3	0	0	3
12	U18PCAS505	PC	Aircraft Stability and Control	3	3	0	0	3
13	U18PCAE601	PC	Finite Element Analysis	3	3	0	0	3
14	U18PCAS602	PC	Heat Transfer	3	3	0	0	3
15	U18PCAS701	PC	Guidance and Control	3	3	0	0	3
16	U18PCAS702	PC	Satellite Technology	3	3	0	0	3
PRACTICAL								
17	U18PCAS3L1	PC	Strength of Materials Laboratory	4	0	0	4	2
18	U18PCAS3L2	PC	Computer Aided Design and Drafting Laboratory	4	0	0	4	2
19	U18PCAS4L1	PC	Aerodynamics Laboratory	4	0	0	4	2
20	U18PCAS4L2	PC	Manufacturing Technology Laboratory	4	0	0	4	2
21	U18PCAS4L3	PC	Introduction to MATLAB	4	0	0	4	2
22	U18PCAE5L1	PC	Aircraft Structures Laboratory	4	0	0	4	2
23	U18PCAS5L2	PC	Gas Dynamics Laboratory	4	0	0	4	2
24	U18PCAS5L3	PC	Flight Simulation Laboratory	4	0	0	4	2
25	U18PCAS6L1	PC	Computer Aided Analysis Laboratory	4	0	0	4	2
26	U18PCAS6L2	PC	Propulsion Laboratory	4	0	0	4	2
27	U18PCAS7L1	PC	Satellite Design Laboratory	4	0	0	4	2
TOTAL				89	45	0	44	67

LIST OF COURSES UNDER Employability Enhancement (EE) Courses such as Project Work, Technical Seminar, Internship, Term Paper etc.,

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18EEAS6L1	EE	Aircraft Design Project	6	0	0	6	3
2	U18EEAS8C1	EE	Comprehension	0	0	0	0	1
Total				6	0	0	6	4

LIST OF COURSES UNDER (PR) Project Work

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PRAS7P1	PR	Project Phase I	3	3	0	0	3
2	U18PRAS8P2	PR	Project Phase II	18	0	0	18	9
Total				21	3	0	18	12

LIST OF COURSES UNDER MANDATORY COURSES (MC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18MCTH401	MC	Constitution of India	2	2	0	0	0
2	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
3	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
4	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
5	U18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
6	18MCAB203	MC	Yoga	2	0	0	2	0

7	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
8	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
9	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
10	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
12	U18MCAB509	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
13	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
14	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
15	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
16	U18MCAB713	MC	Behavioral and Interpersonal Skills	2	0	0	2	0
17	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
18	U18MCAB818	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL				36	6	0	36	0

Subject code: U18HSEN101	**Subject Name : COMMUNICATIVE ENGLISH (Common to B. Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – School Level English				
	Course Coordinator Name & Department:- Mr. M. Gopinath& Dept. of English				
COURSE OBJECTIVES:-	Enhance the learner's communication skills by giving adequate exposure in LSRW – Listening, Speaking, Reading, Writing skills and the related sub-skills. Help the learners recognize and operate in various styles and registers in English.				

UNIT I SPEAKING

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal

Presentations introducing oneself – exchanging personal information- narratingevents, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development – prefixes- suffixes - articles, prepositions.

UNIT II READING

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun pronoun agreement

UNIT IV WRITING Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Pre

UNIT V LANGUAGE DEVELOPMENT Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-listening to talks, conversations to complete the remaining, participating in conversations-short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence-Organizing principles of paragraphs in documents- Techniques for writing precisely

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007

5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES (COs)	
CO1	Enable students to learn and identify faulty pronunciation, grammar and vocabulary. (Understand)
CO2	Help students develop the knowledge, skills and strategies to become proficient and independent readers and make them to interact and construct meaning from the content.(Analyze)
CO3	Develop listening abilities of the students, and teach basic listening strategies and expose them to a number of different listening situations through activities. (Remember)
CO4	Impart writing skills by sensitizing the learners to the dynamics of effective writing. (Create)
CO5	Recognize culture-specific perspectives and values embedded in language behavior to make students interpret authentic texts of different genres. (Analyze)
CO6	Communicate effectively using verbal and non-verbal communication skills. (Apply)

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1		H										M
	CO2			M							M		
	CO3				H							H	
	CO4					H		M					
	CO5						H		H	L			
	CO6												
3	Category	Basic Sciences (BS)											
4	Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSMA101	**Engineering Mathematics – I (Common to B. Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite Course– School Level Mathematics				
	Course Coordinator Name & Department – Ms. J. Aiswarya& Department of Mathematics				
COURSE OBJECTIVES	➢ The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. ➢ It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3) Hrs

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3) Hrs

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3) Hrs

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3) Hrs

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3) Hrs

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXTBOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition
Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	Analyze the optimum solution of various engineering problems involving single variables.
CO2	Know the basic concepts of integration and evaluating the problems which involves Beta and Gamma functions.
CO3	Solve the differential functions and optimizes the problems with two variables functions.
CO4	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three-dimensional spaces.
CO5	Evaluate Eigenvalue and eigen vector problems from practical areas using transformations;
CO6	Construct the eigen vector for the problem in engineering field and Diagonalizing the matrix

Mapping of Course Outcomes with Program outcomes (POs) **H –High, M-Medium, L-Low**													
1	**COs/Pos**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	**CO1**	H	H										L
	CO2	H	H			M							M
	CO3	H	H	M		M							M
	CO4	H	H			M							M
	CO5	H	H	M									L
	CO6	H	H										L
3	**Category**	Basic Science (BS)											
4	**Approval**	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	WAVES AND OPTICS (For B.Tech –Common to all branches)	L	T	P	C
	Total contact hours -45	3	0	0	3
	Prerequisite: +2				
	Course offered by –Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity. **(Contact Hours - 9)**

UNIT 2 ULTRASONIC WAVES

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.**(Contact Hours - 9)**

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.**(Contact Hours - 9)**

UNIT 4 WAVE OPTICS

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power.**(Contact Hours - 9)**

UNIT 5 LASERS

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.**(Contact Hours - 9)**

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org
9)

COURSE OUTCOMES(COs)	
CO1	Describe the basic concept of waves (Understand)
CO2	Identify the importance of Ultrasonic waves (Understand)
CO3	Recognizethe propagation of light and geometrical optics (Remember)
CO4	Discuss the optical phenomenon like interference, diffraction and superposition of waves (Understand)
CO5	Observe the concept of laser and its applications (Understand)
CO6	Examine the properties of light and sound waves and its wide range of applications(Apply)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	M										
	CO2	H	M	H									
	CO3	H	M										
	CO4	H	M	L									
	CO5	H	M	H									
	CO6	H	M	H									
3	Category	**Basics Sciences(BS)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	Subject Name: ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course: +2				
	Course Offered by : Dept.of.Chemistry				
	Data Book/ Codes/ Standards : Periodic Table				

UNIT I WATER TECHNOLOGY (Contact Hours – 09)

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS (Contact Hours – 09)

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead. Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non-ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES (Contact Hours – 09)

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS (Contact Hours – 09)

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method-

Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels-water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY (Contact Hours – 09)

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	Discuss boiler feed water requirements and water treatment techniques **(Understand)**
CO2	Explain the industrial importance of Phase rule and its applications to one and two component systems **(Apply)**
CO3	Illustrate the principles of Conventional and non- conventional energy sources and energy storage devices **(Understand)**
CO4	Describe the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels **(Remember)**
CO5	Classify Nanomaterials and state their applications in biology and medicine **(Understand)**
CO6	Describe the industrial requirements for resources, energy and materials administer **(Apply)**

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	**COs/Pos**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	**H**			**M**		**H**		**H**				
	CO2		**L**	**H**		**M**		**H**		**M**	**H**		
	CO3		**M**		**H**		**L**						

	CO4	**H**		**M**	**L**			**M**					
	CO5		**H**		**L**		**M**				**M**		
	CO6	**M**									**H**		
3	**Category**	Basic Sciences (BS)											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Computer Science and Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition , Updated for Python3, Shroff/O'Reilly Publishers, 2016
2. (http://greenteapress.com/wp/think-python/)
3. Guido van Rossum and Fred L. Drake Jr,— An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Understand basic of algorithmic solutions to find simple computational problems.
CO2	Execute basic syntax, data expressions and programs in Python.
CO3	Apply conditional statements and functional parameters to read and write input/output files
CO4	Analyze list operations, tuples assignments, various dictionaries and sorting methods.
CO5	Remember user-defined functions, modules and packages.
CO6	Implement the exception and file handling operations using various list parameters.

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	L										
	CO2	H	M										
	CO3	M	M	M									
	CO4	H	H	H	L	L							
	CO5	H		M		M							
		M	M										
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	Engineering Graphics & Design (Theory & Lab.)	L	T	P	C
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – Higher Secondary School Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet des needs, using the techniques, skills, and modern engineering tools necessary engineering practice				

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP;

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4: SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True

shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.
CO6	Crete 3D part models. Develop its surfaces with solid modelling software for assembly of parts

Mapping of Course Outcomes with Student Outcomes (SOs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M			H					
	CO2	H	H	L		H	M						
	CO3			H									
	CO4											H	
	CO5	H						L					
	CO6	M		H		H					H		
3	Category	Engg Sciences (ES)											

4	Approval	47th Meeting of Academic Council held in Aug, 2018	

U18BSPH2L1	**WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech. –Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	**L**	**T**	**P**	**C**
	Total contact hours - 30	**0**	**0**	**4**	**2**
	Prerequisite: Wave Optics and Mechanics				
	Course offered by – Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

PHYSICS LAB EXPERIMENTS FOR SEMESTER I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

COURSE OUTCOMES(COs)	
CO1	Achieve the fundamental concept of optics (Precision)
CO2	Demonstrate the concept of production of ultrasonic waves (Manipulate)
CO3	Achieve the basic concept of mechanics (Precision)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H	H						H		
	CO2	H		H									
	CO3	H		M	H						H		

3	Category	**Basics Sciences(BS)**
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Estimate certain properties of water, Standardize solutions using titration, Conductivity meter, pH-meter **(Understand)**
CO2	Recognize basic principle of spectrophotometric method **(Remember)**
CO3	Analyze some important physical properties like viscosity and rate of Corrosion of the samples **(Analyze)**

Mapping of Course Outcomes (COs) with Progrmme Outcomes (POs)

(H/M/L indicates strength of correlation) : H – High, M – Medium, L – Low

COs/POs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H									
CO2	M			M	H							
CO3	H	H	H			H	H	M				
Category	Basic Sciences (BS)											

Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. ExSOnentiation (SOwer of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib
CO6	To Understand about Simulate bouncing ball using Pygame.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

2	CO1	M		M		M				M			
	CO2	M		M	H	M				M			
	CO3	M		M	H	M				M			
	CO4	M		M		M				M			
	CO5	M		M		M				M			
	CO6	M		M	H	M				M			
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18HSEN201	**TECHNICAL ENGLISH**	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite course –1 Semester English				
	Course Coordinator Name & Department:- Mr. M. Gopinath& Dept. of				
OBJECTIVES	➢ Train the students in technical writing in English in writing descriptions of gadgets, Preparing texts and reports as well as comprehending technical texts. Prepare the students in content writing and copy editing				

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependent, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	Develop global listening abilities of the students, and teach them a few basic listening strategies and expose them to a number of different listening situations through activities. (Understand)
CO2	Help students develop the knowledge, skills and strategies they must possess to become proficient and independent readers who is able to interact and construct meaning from the content. (Apply)
CO3	Use technical information and knowledge in practical documents for a variety of professional audiences, including peers and colleagues or management, and public audiences.(Apply)
CO4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Create)
CO5	Help students recognize culture-specific perspectives and values embedded in language behavior. Decode, analyze, and interpret authentic texts of different genres. (Evaluate)
CO6	Designing digital slides. Breaking up a presentation into parts of reasonable length. Using statistics effectively to persuade an audience. Incorporating concrete examples and stories to illustrate points. (Create)

COs \POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										H
CO2			H							M		
CO3				H							H	
CO4					M		H					
CO5						M		M	L			
CO6												
Category			Humanities and Social Studies (HS)									
Approval			47th Meeting of the Academic Council									

U18BSMA201	**Engineering Mathematics II (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	**3**	**1**	**0**	**4**
	Prerequisite Course– School Level Mathematics				
	Course Coordinator Name & Department – Dr. N. Ramya& Department of Mathematics				
COURSE OBJECTIVE	➢ The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables. ➢ Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.
5.

COURSE OUTCOMES (COs)	
CO1	Solve the higher order differential equations with constant and variable coefficients.
CO2	Apply Green's, Stoke's and Gauss Theorems in the application of engineering problems which involves line, surface and volume integrals .
CO3	Understand the analytic functions and able to construct an analytic function, solve the conformal mapping
CO4	Evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	Apply the concept of Laplace Transformation in analysis.
CO6	Use Laplace transform methods to solve differential equations.

Mapping of Course Outcomes with Program outcomes(POs)
H –High, M-Medium, L-Low

1	**COs/POs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	**CO1**	H	H			M							L
	CO2	H	H	L		L							M
	CO3	H	H	M		M							M
	CO4	H	H	M		L							H
	CO5	H	H	M									H
	CO6	H	H										H
3	**Category**	Basic Science (BS)											
4	**Approval**	47th Academic Council Meeting held in Aug, 2018											

U18BSPH201	**INTRODUCTION TO MECHANICS (Common to B.Tech. –Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	**L**	**T**	**P**	**C**
	Total contact hours -45	3	0	0	3
	Prerequisite: +2				
	Course offered by –Department of Physics				
	Data Book/Codes /Standards : Higher Secondary				

UNIT I -Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates**(Contact Hours – 9)**

UNIT II - Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits. **(Contact Hours – 9)**

UNIT III - Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance**(Contact Hours – 9)**

UNIT IV - Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body**(Contact Hours – 9)**

UNIT V - Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with centre of mass fixed. **(Contact Hours – 9)**

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" DhanpatRai Publications" 2012.
2. M.K. Harbola, "Engineering Mechanics", 2nd edition, Cengage, 2013.

3. M.K. Verma, “Introduction to Mechanics”, 1st edition, CRC press, 2009.
4. D.Kleppner&RKolenkow, “An Introduction to Mechanics”, McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, “Engineering Mechanics – DynamicsVol 2”, 7th ed. Wiley, 2012
6. JP Den Hartog, “Mechanical Vibrations”, Dover Publications, Inc., 1985
7. WT Thomson, “Theory of Vibrations with Applications”, Pearson, 5th edition, 1997.

Online References: Wikipedia org

COURSE OUTCOMES(COs)	
CO1	Identify and solve the various equation of motions in different coordinate systems (Remember)
CO2	Generalize the idea of conservation of energy and angular momentum (Understand)
CO3	Visualize the concept of harmonic motion in different damped conditions (Remember)
CO4	Discuss the motion of a rigid body under different criteria (Understand)
CO5	Describes the motion of a rigid body in three dimensions (Understand)
CO6	Demonstrates the basics of particle motion and kinematics in 1D, 2D and 3D (Apply)

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	M										
	CO2	H											
	CO3	H	M										
	CO4	H	H	M	H								
	CO5	H	H	M	H	H					H		H
	CO6	H			M						H		
3	Category	**Basics Sciences(BS)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	ENVIRONMENTAL SCIENCES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course +2				
	Course Offered by Dept of Chemistry				
OBJECTIVES	➢ To study the interrelationship between living organism and environment. ➢ To study of the nature and concepts of ecosystem. ➢ To learn about the integrated themes and biodiversity of an environment. ➢ To study of pollution control and waste management. ➢ To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste

Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Observe the overutilization of water and energy from different sources, conserve water and identify alternative energy sources **(Remember)**
CO2	Explain different ecosystem, identify possible solutions to environment issues
CO3	Describe the biodiversity, its importance and conservation **(Remember)**
CO4	Explain various forms of environment pollution and realize the responsibilities of individuals in prevention of pollution **(Apply)**
CO5	Identify the social and environmental issues and predict the possible engineering solutions **(Understand)**
CO6	Describe the social and environmental problems and administer the possible solutions **(Apply)**

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	**CO/PO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
2	**CO1**	**H**			**M**								
	CO2	**M**	**H**	**H**		**M**							**L**

	CO3		**M**										
	CO4	**H**		**M**	**L**								**M**
	CO5		**H**		**L**						**H**		
	CO6										**H**		
3	Category	Humanities and Social Sciences (HS)											
4	Approval	47th Meeting of Academic Council											

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector					

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System - types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3.

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)													
CO1	Recall the relationship between structure and function of cells at molecular level												
CO2	List the defining characteristics of biological life												
CO3	Determine the importance of genetics and immunological response												
CO4	Categorize the mechanism of infection about diseases and disorders affecting specific organs												
CO5	Demonstrate the techniques from multiple disciplines and apply to biological problems												
CO6	Discuss the biological science related to different disciplinary areas.												
Mapping of Course Outcomes with StudentsOutcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	L											L
	CO2	L											
	CO3	M											
	CO4	L											
	CO5	H					L						L
	CO6	M											L
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE101	**Basic Electrical and Electronics Engineering**	**L**	**T**	**P**	**C**
	Total contact hours-45	**3**	**0**	**0**	**3**
	Prerequisite: School Level Physics				
	Course offered by –Department of Electrical and Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications.				

MODULE 1 :DCCIRCUITS (12 periods)

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2:AC CIRCUITS (9 Periods)

Representationofsinusoidalwaveforms,peakandrmsvalues,phasorrepresentation,realpower, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and deltaconnections.

MODULE 3: ELECTRICAL MACHINES&TRANSFORMERS (9 Periods)

Principles of operation and characteristics of; DC machines, Synchronous machines, threephase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer.

MODULE 4: SEMICONDUCTOR DEVICESANDAPPLICATIONS (9 periods)

CharacteristicsofPNJunctionDiode–ZenerEffect–ZenerDiodeanditsCharacteristics–Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction toOP-AMP.

MODULE 5:DIGITALELECTRONICS (6 Periods)

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird,, Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition.2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning,2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press,2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition,2011.

5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition,2015.
6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition,2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers,2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Higher Ed, 1st Edition,2011.
3. Jacob Millman and Christos C-Halkias,“Electronic Devices and Circuits”, McGraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES(COs)	
CO1	Apply simple electrical circuits and verify DC network theorems.**(Apply)**
CO2	Obtain electrical parameters like voltage, current, power and sketch phase diagram of a given ac circuits. .**(Understand)**
CO3	Explain the working principle of DC, AC Machines and transformer.**(Understand)**
CO4	Draw the characteristics of semiconductor devices and to obtain signal analysis of BJT **(Understand)**
CO5	Perform the basic Boolean operations. **(Remember)**

Mapping of course outcomes with programme outcomes(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	L	L	-	-	-	-	-	-	-	-
	CO2	H	M	L	L	-	-	-	-	-	-	-	-
	CO3	H	L	-	-	-	-	-	-	-	-	-	-
	CO4	H	-	L	L	-	-	-	-	-	-	-	-
	CO5	H	M	M	L	-	-	-	-	-	-	-	-
3	Category	**Engineering Science(ES)**											
4	**Approval**	47th Meeting of Academic Council held in Aug, 2018											

U18ESME1L2	Workshop/Manufacturing Practices Laboratory	L	T	P	C
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

Lectures & videos: (15 hours)

1. Detailed contents
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lecture)
3. CNC machining, Additive manufacturing (2 lecture)
4. Fitting operations & power tools (2 lecture)
5. Carpentry (2 lecture)
6. Plastic moulding, glass cutting (2 lecture)
7. Metal casting (2 lecture)
8. Welding (arc welding & gas welding), brazing (2 lecture)

WORKSHOP PRACTICE:

Machine shop (6 hours)

1. Facing
2. Turning
3. Drilling Practice

Fitting shop (6 hours)

1. Fitting Exercises–Preparation of square fitting
2. Vee–fittingmodels.

Carpentry (9 hours)

a) Preparation of Lap joints.
b) Mortise and Tenonjoints.
c) Cross Half joints.
d) Dove Tail joints.

Welding shop (Arc welding 6 hrs + gas welding 3 hrs) (9 hours)

Preparation of butt joints, lap joints and Tee joints

Sheet Metal working (9 hours)

Forming &Bending:
Model making–Trays, funnels, etc.
Different type of joints

Demonstration (6 Hours)

Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1											S	
	CO2			S	M								
	CO3		M									S	
	CO4	S			W							S	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE1L3	BASIC ELECTRICAL AND ELECTRONIC ENGINEERING PRACTICES LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and CurrentLaws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a stepchangeinvoltage(transientmaybeobservedonastorageoscilloscope).Sinusoidalsteadystate response of R-L, and R-C circuits – impedance calculation andverification.
3. Fluorescent lampwiring.
4. Staircasewiring.
5. Measurement of energy using single phase energymeter.
6. Observationoftheno-loadcurrentwaveformonanoscilloscopeandMeasurementofPrimary and secondary voltages and currents of aTransformer.
7. Demonstration of cut-out sections of machines: dc machine (commutator-brusharrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase inductionmachine.
8. Demonstrationof(a)dc-dcconverters(b)dc-acconverters–PWMwaveform(c)theuseofdc-acconverter for speed control of an induction motor and (d) Components of LTswitchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and functiongenerator.
2. Characteristics – Half wave and Full waveRectifiers.
3. Characteristics – Common Base transistorconfiguration.
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK andRS.
5. Applications of OperationalAmplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES(COs)													
CO1	Implementation of circuits for verification of basic laws and theorems**(Imitation)**												
CO2	Perform the different types of residential wiring and to measure the electrical quantities like voltage ,current and power.**(Manipulation)**												
CO3	Draw the characteristics of semiconductor devices**(Imitation)**												
Mapping of course outcomes with programme outcomes(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	L	L	M	H	L	-	-	-	M	-	-	-
	CO2	L	L	M	H	L	-	-	-	M	-	-	-
	CO3	L	L	M	H	L	-	-	-	M	-	-	-
3	Category	**Engineering Science(ES)**											
4	**Approval**	47th Meeting of Academic Council, May 2018											

SEMESTER III

U18BSMA302	**Partial Differential Equations, Probability and Statistics (Common to B. Tech – Mech, Mechatronics, Automobile and Aero Engineering admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours -60	**3**	**1**	**0**	**4**
	Prerequisite Course– Engineering Mathematics I & II				
	Course Coordinator Name & Department – K.L. Rajashree& Department of Mathematics				

OBJECTIVE:

- Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.
- Learn techniques of solving the standard types of first order and second order partial differential equations.
- Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem.
- Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases. Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT IV PROBABILITY DISTRIBUTION 12

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS 12

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXTBOOKS:

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993. [Units I to V].

2. S.C.Gupta&V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2003. [Units I to III].

REFERENCES:

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. “Applied Statistics and Probability for Engineers”, 6th Edition. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. “Quality and Reliability in Engineering”. Book Vistas, New Delhi.

WEBLINKS:

https://nptel.ac.in/courses/111105093/
https://onlinecourses.nptel.ac.in/noc18_ma12/preview

	COURSE OUTCOMES (COs)
CO1	Apply Fourier series method to engineering problems. (Apply)
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results. (Apply)
CO3	Analyze the solutions ofone dimensional and two dimensional boundary value problems in partial differential equations.(Analyze)
CO4	Apply the concept of probability to various distributions in engineering problems. (Apply)
CO5	Evaluate thestatistical problems including measures of central tendency, correlation and regression. (Evaluate)
CO6	Analyse the testing of hypothesis to statistical data. (Analyze)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H	H	L		L							L		
	CO2	H	H	L		M							M		
	CO3	H	H	M		L							M		
	CO4	H	H	M	L	L							L		
	CO5	H	H	L	M	M							M		
3	**Category**	**Basics Sciences(BS)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS301	**INTRODUCTION TO AEROSPACE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**2**	**0**	**0**	**2**
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To help the student understand the history of aviation, different kinds of aircrafts, spacecrafts, their components and functioning.					

UNIT I EVOLUTION OF FLIGHT 4

Brief history of Aviation-Hot air balloon and heavier than air flying machines-early airplane configurations-Modern Airplanes-Components of airplane and their functions-Rotary wing aircrafts-Space vehicles.

UNIT II FUNDAMENTALS OF AERODYNAMICS 10

International Standard Atmosphere-Pressure, Temperature and Density altitude, Bernoulli's equation-Mach number-subsonic, transonic, sonic and supersonic flow regimes, Measurement of pressure and airspeed- IAS,EAS and TAS. Airfoil geometry and nomenclature - airfoil characteristics - lift, drag and moment coefficients-angle of attack-aspect ratio- induced drag and parasite drag.

UNIT III AEROSPACE STRUCTURES 4

Structural components of an airplane- monocoque and semi monocoque structure –materials for structural components – composite materials and their significance in Aviation Technology.

UNIT IV AEROSPACE PROPULSION 8

Propeller Engine – Gas Turbine Engine – Turbo prop, Turbo jet, Turbo fan Engines - variation of thrust, power and specific fuel consumption with speed and altitude – materials for engine components.

UNIT V SPACE VEHICLES AND ASTRONAUTICS 4

Basics of Rocket Technology – escape velocity – re-entry vehicles – Satellite technology– Hypersonic vehicles, Elements of Astronautics.

TEXTBOOKS:

1. Anderson, J. D., Introduction to Flight, Tata-McGraw-Hill Higher Education, 6th edition 2010.

REFERENCES:

1. Kermode, A. C, Barnard, R. H and Philpott, D. R, Mechanics of Flight, Pearson education, 2012.
2. Shevell, R. C., Fundamentals of Flight., Prentice hall (2nd edition), 1989.
3. Steven, A. Brandt, Randall J. Stiles, John J. Bertin and Ray Whitford, Introduction to Aeronautics: A Design Perspective, AIAA Education series (2nd edition),2004.
4. Torenbeek, E and Wittenberg, H, Flight Physics:Essentials of Aeronautical Disciplines and Technology, with Historical Notes, Springer, 2009.

WEBLINKS:

https://www.edx.org/course/introduction-to-aeronautical-engineering

COURSE OUTCOMES	
CO 1	**Describe** the basic components of airplane and various flight vehicles. (**Remember**)
CO 2	**Summarize** the variation of aircraft performance at various altitudes. (**Understand**)
CO3	**Explain** the structural components of airplane and materials used for aircraft construction. (**Understand**)
CO4	**Describe** the working of different types of aircraft engines and their performances. (**Understand**)
CO5	**Discuss** the theory behind rocket propulsion and the problems associated with hypersonic vehicle operation. **(Understand)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H									M				H
	CO2	H				M									H
	CO3	H									M		H		H
	CO4	H											H		H
	CO5	H											H		H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS302	APPLIED DYNAMICS AND VIBRATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enable the student to understand about the basics of mechanics, working of machines, the forces acting on different machines and the corresponding motion, prediction and design of machines.

UNIT I EQUILIBRIUM OF RIGID BODIES 9

Free Body Diagram, Equilibrium of Forces and Moments, Lame's theorem, Parallelogram and Triangle Law of Forces, Force Resolution, Types of Supports and Reactions, Requirements of Stable Equilibrium, Moments and Couple – Moment of force about a point and about an axis, Vector operation of forces, Resolution of Forces, Resultant of Several Concurrent Forces, Forces in Space

UNIT II PROPERTIES OF SURFACES AND SOLIDS 8

Determination of Areas, First Moment of Area and the Centroid of Standard Sections – T Section, I Section, Composite Figures, Hollow Section – Second Moments of Plane Area (Rectangle, Triangle, Circle, T Section, I Section, Hollow Section), Parallel Axis Theorem, Perpendicular Axis Theorem, Polar Moment of Inertia, Principal Moments of Inertia of Plane Areas – Basic Concepts of Mass Moment of Inertia

UNIT III MECHANISMS 10

Machine and Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom –Kutzbach criterion - Slider crank and crank rocker mechanisms – Inversions – Applications –Kinematic analysis of simple mechanisms – Determination of velocity and acceleration. – Introduction to Gears and Cams

UNIT IV FRICTION AND FORCE ANALYSIS 10

Frictional force, Laws of Coulomb Friction, Cone of Friction, Angle of Repose, Belt(Flat and Vee) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive. Introduction to force analysis –Static and dynamic balancing Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing

UNIT V INTRODUCTION TO VIBRATIONS 8

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation –Vibration absorption –Torsional vibration of shaft –Single and multi rotor systems – Geared shafts–Critical speed of shaft.

TEXTBOOKS:

1. F. P. Beer, E.R. Johnston, and J.T. Dewolf, Mechanics of Materials, McGraw-Hill (4th edition), 2006 (Unit 1 & 2)
2. Rattan.S.S., Theory of Machines, Tata McGraw–Hill Publishing Co, New Delhi, 2004. (Unit 3 to 5)

REFERENCES:

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, WileyEastern Ltd., 1992.

2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", SatyaPrakasam, Tech. IndiaPublications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press,1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.
6. Balaguru. S., Dynamics of Machinery, SciTech publication (2nd edition), 2009.

WEBLINKS:

www.simplemachines.org/

ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5593596

https://onlinecourses.nptel.ac.in/noc19_me29/preview

	COURSE OUTCOMES
CO1	**Identify** the forces and its magnitude. **(Remember)**
CO2	**Discuss** the moment under area consideration with C.G Locations. **(Understand)**
CO3	**Describe** the working of different mechanisms along with inversion and their corresponding velocity and acceleration diagrams. (**Apply**)
CO4	**Determine** the Power transmission in machine elements using fundamentals of friction and the unbalanced forces acting on rotating and reciprocating parts in engine. (**Apply**)
CO5	**Determine**the Cause of vibration in machine parts and its effects **(Apply)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H				H									H
	CO2	H													H
	CO3	H				H					H				H
	CO4	H				H					H				H
	CO5	H													H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18ESAS301	FUNDAMENTALS OF FLUID MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To help the student understand the basic physics of fluids, fluid behavior under different conditions, laws governing fluid flows, measurements in fluids and functioning of fluid machinery.

UNIT I INTRODUCTION 7

Fluid –definition-Fluid properties-Newton's law of viscosity-Classification of fluids-fluid statics-Hydrostatic forces on submerged surfaces- basics of Stability of floating bodies

UNIT II FLUID FLOW ANALYSIS AND FLOW MEASUREMENT 10

Ideal and real flow-Concept of continuum-Eulerian and Lagrangian approaches-Velocity field-Pathline, Streakline, Streamline- Stream tube- Fluid acceleration-Continuity, momentum differential equations-Navier Stokes equation-Bernoulli's equation and its applications-Venturimeter-Orifice meter, Coefficient of Discharge, Flow Rate and Velocity Measurement.

UNIT III DIMENSIONAL ANALYSIS 8

Dimensional Homogeneity, Buckingham's Pi Theorem-Non dimensional numbers and their significance-Flow similarity, similitude, incomplete similarity and model studies – distorted models

UNIT IV FLOW THROUGH PIPES 11

Laminar and turbulent flow- Boundary layer flow – Boundary layer thickness - Reynolds number and its significance-Laminar fully developed pipe flow-Hagen-Poiseuille flow-Coefficient of friction-Head loss – Darcy-Weisbach equation-Hydraulic gradient- Total energy lines-Moody's diagram

UNIT V FLUID MACHINERY 9

Classification of fluid machines-Reciprocating and centrifugal pumps-impulse and reaction turbines and velocity triangles-Working principle of Pelton, Francis and Kaplan turbines

TEXTBOOKS:

1. Rathakrishnan. E, Fundamentals of Fluid Mechanics, Prentice-Hall (3rd edition), 2012.

REFERENCES:

1. Bansal. R. K., "A textbook of Fluid Mechanics", Laxmi Publications, 2008
2. Frank M White, Fluid Mechanics, The McGraw Hill companies. (7th edition), 2011.
3. Yunus A Cengel and John M Cimbala, Fluid mechanics: Fundamentals and Applications, Tata McGraw Hill (2nd edition), 2010.
4. Irving H Shames, Mechanics of Fluids, The McGraw Hill companies (4th edition), 2003.
5. Yuan, S.W, Foundations of Fluid Mechanics, Prentice-Hall, 1967.

WEBLINKS:

reu.eng.ua.edu › Programs
www.fluidmechanics.co.uk/
https://onlinecourses.nptel.ac.in/noc17_me04/course

COURSE OUTCOMES	
CO1	**Recall** the concepts of fluids, properties of fluids and its classification. (**Remember**)
CO2	**Calculate** the flow properties using the fundamental equations of fluid motion. (**Apply**)
CO3	**Solve** problems based on dimensional analysis and fluid flow analysis. (**Apply**)
CO4	**Examine t**he pipe line system for minimum head loss. (**Apply**)
CO5	**Calculate** the performance and operating characteristics of turbines and pumps. **(Apply)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													H
	CO2	H													H
	CO3	H											L		H
	CO4	H									H				H
	CO5	H									H				H
3	**Category**	**Engineering Science (ES)**													
4	**Approval**	**48th Academic Council Meeting**													

U18ESAS302	**FUNDAMENTALS OF AERO – THERMODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the student understand about the basics of engineering thermodynamics, various laws and their applications, prediction of thermodynamic performance of various engines, and other thermal devices.					

(Use of Steam Tables is Permitted)

UNIT I BASIC CONCEPTS AND FIRST LAW 7

Continuum, microscopic and macroscopic approach, thermodynamic system and surrounding, state, path, process, heat and work, zeroth law, concept of ideal and real gases, internal energy, specific heat capacities, enthalpy, first law of thermodynamics – PMM-1

UNIT II FIRST LAW APPLIED TO FLOW PROCESSES 10

Control volume – steady flow processes – steady flow energy equation – mass and energy balance – example of steady flow processes – variable flow processes

UNIT III SECOND LAW AND ENTROPY 11

Second law of thermodynamics, Kelvin – Planck's and Clausius Statements, PMM-2, reversibility and irreversibility, Carnot theorem, refrigerator, heat engine and heat pump, concept of entropy, irreversibility, Clausius inequality, principle of increase in entropy, absolute entropy, entropy generation in open and closed systems, entropy change in non-flow processes, availability, energy

UNIT IV AIR POWER CYCLES 9

Carnot, Otto, Diesel, Dual, Stirling and Ericsson cycle - Air standard efficiency – Mean effective pressure

UNIT V BRAYTON CYCLE 8

Introduction to aircraft propulsion – gas turbine engine cycles – open and closed Brayton cycle – Brayton cycle with reheat, regeneration and intercooling.

TEXTBOOKS:

1. Rathakrishnan E., Fundamentals of Engineering Thermodynamics, Prentice-Hall India, 2012.

REFERENCES:

1. Nag.P.K.,Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
2. Yunus A Cengel and Michael A Boles., Thermodynamics- an Engineering approach, McGraw Hill Education (7th edition), 2012.
3. Holman.J.P.,Thermodynamics, McGraw-Hill (3rd edition), 2007.
4. Merle C Potter and Craig W Somerton., Thermodynamics for Engineers, Schaum's Outline Series, Tata McGraw-Hill (2nd edition), 2009.

WEBLINKS:

www.thermocalc.com/
www.grc.nasa.gov/WWW/cdtb/software/t-mats.html
https://www.edx.org/course/thermodynamics-2

COURSE OUTCOMES	
CO1	**Discuss** the fundamental laws of thermodynamics and its relations. **(Understand)**
CO2	**Solve** thermodynamic problems on first law of thermodynamics. **(Apply)**
CO3	**Solve** thermodynamic problems on Second law of thermodynamics. **(Apply)**
CO4	**Compute** the air standard efficiencies using P-V and T-S diagram of various air power cycles. (**Apply**)
CO5	**Calculate** the efficiency of jet propulsion cycles. (**Apply**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													H
	CO2	H											H		H
	CO3	H									H		H		H
	CO4	H													H
	CO5	H									H				H
3	**Category**	**Engineering Science (ES)**													
4	**Approval**	**48th Academic Council Meeting**													

U18ESAS303	**FUNDAMENTALS OF STRUCTURAL MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To equip the students with the basics of structural mechanics and materials, material behavior & failure under load, its prediction and design based on it.					

UNIT I INTRODUCTION TO STRENGTH OF MATERIALS 10

Introduction to mechanics of deformable bodies - Material selection criteria – stress – strain – Stress and strain diagram - Hook's law - Elastic constants – definition of engineering constants: elastic moduli – Young's modulus, Bulk Modulus& Volumetric Strain, Poisson's ratio, Shear Modulus, relation between three elastic moduli and Poison's ratio, Statically determinate and indeterminate problems in tension and compression – Thermal stress – Impact loading – Composite bars

UNIT II STRESSES IN BEAMS 9

Shear force and bending moment diagrams for simply supported, cantilever beams and overhanging beams– bending stress variation in beams of symmetric sections, neutral axis

UNIT III DEFLECTION OF BEAMS 9

Double integration, Macaulay's method, moment area method, conjugate beam method, method of superposition, Maxwell's reciprocal theorem.

UNIT IV TORSION 8

Torsion of solid and hollow circular shafts – Power transmission in shafts – Open and closed-coiled helical springs – Stresses in helical springs.

UNIT V BI – AXIAL STRESSES AND ELEMENTS OF ELASTICITY 9

Stresses in thin cylindrical and spherical shell under internal pressure and volumetric strain– Principle stresses and maximum shear stresses– Combined loading – Mohr's circle and its construction – concept of theory of elasticity, basic assumptions, coordinate transformation, plane stress and plane strain conditions, stress tensor

TEXTBOOKS:

1. Gere & Timoshenko, Mechanics of Materials, McGraw Hill, 1993

REFERENCES:

1. F. P. Beer, E.R. Johnston, and J.T. Dewolf, Mechanics of Materials, McGraw-Hill (4th edition), 2006
2. Dym,C.L., and Shames,I.H., Solid Mechanics, McGraw Hill, Kogakusha, 1973.
3. Stephen Timoshenko, Strength of Materials, Vol I & II, CBS Publishers and Distributors, Third Edition.
4. R.K. Rajput, Strength of Materials, S. Chand and Co., 1999.
5. William Nash, Strength of Materials, Tata McGraw Hill, 2004
6. Timoshenko,S. and Young,D.H., Elements of Strength of Materials, T.VanNostrand Co. Inc., Princeton, N.J., 1977.

WEBLINKS:

www.mdsolids.com/
https://onlinecourses.nptel.ac.in/noc17_ce22/preview

https://www.actuspotentia.com/MechMat.shtml

COURSE OUTCOMES	
CO1	**Compute** the stress developed in statically determinate and indeterminate structures subjected to axial load. (**Apply**)
CO2	**Sketch** shear force and bending moment diagram for a given beam. (**Apply**)
CO3	**Determine** the deflection of beams using various methods (**Apply**)
CO4	**Compute** the shear stress developed in circular shafts and springs subjected to torsional and axial load. (**Apply**)
CO5	**Determine** principal stresses developed in structural components using Mohr'sCircle (**Apply**).

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H									H				H
	CO2	H				M									H
	CO3	H											M		H
	CO4	H											M		H
	CO5	H				M					H				H
3	**Category**	**Engineering Science (ES)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS3L1	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the students with hands on experience on conducting various structural tests to determine the structural properties of a given material.

LIST OF EXPERIMENTS

1 Tension test of a mild steel and aluminium rod.
2 Shear test on mild steel and aluminium rod.
3 Torsion test on mild steel rod.
4 Hardness test (a) Brinell& (b) Rockwell.
5 Impact tests (a) Izod& (b) Charpy.
6 Estimation of Stiffness of a Helical Spring (a) Open Coil & (b) Closed Coil
7 Fatigue test: Rotating beam.
8 Block compression test.
9 Flexural test by 3 point bending method
10 Determination of fracture strength and fracture pattern of ductile and brittle material.

REFERENCES:

1. Strength of Materials Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=D8U4G5kcpcM
https://www.youtube.com/watch?v=jpogdcw_Uh0

COURSE OUTCOMES	
CO 1	**Carry out** elementary mechanical coupon testing of materials as per the given procedure. **(Imitation)**
CO 2	**Acquire** data using the available measuring devices. **(Manipulation)**
CO 3	**Perform** basic mathematical calculation using the appropriate formulae and represent the results in form of graph and table **(Precision)**.

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H								H	H				H
	CO2	H								H	H				H
	CO3	H								H	H				H
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18PCAS3L2	COMPUTER AIDED DESIGNING AND DRAFTING	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Engineering Graphics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with a practical experience of engineering drawing in the computer using commercial software packages.

LIST OF EXPERIMENTS

1 Study of various software for engineering design and drafting
2 Study of commercial software packages and their tools
3 Exercise on 2D drawing
4 Exercise on pad and groove
5 Exercise on shaft, mirror and array
6 Exercise on threading, bores and tappings
7 Exercise on part assembly
8 Exercise on drafting
9 Exercise on surface modeling
10 Exercise on kinematics

REFERENCES:

1. CADD Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://grabcad.com/tutorials

COURSE OUTCOMES	
CO 1	**Master** the geometrical profile and modification tools. **(Precision)**
CO 2	**Create** 3-Dimensional models from 2-Dimensional geometries. **(Naturalization)**
CO 3	**Design** basic Aerospace components using CADD. **(Articulation)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H	H							H	H			H	H
	CO2	H	H							H	H			H	H
	CO3	H	H							H	H			H	H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18ESAS3L1	**FLUID MECHANICS AND MACHINERIES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**4**	**2**
	Prerequisite – Nil				
	Course Designed by – Department of Civil Engineering				

OBJECTIVE: To equip the students with hands on experience on conducting various experimental tests to determine the fluid properties of a given fluid and also to assess the performance of various fluid machinery.

LIST OF EXPERIMENTS

1 Determination of pipe flow losses.
2 Calibration of orifice meter and venture meter.
3 Flow through notches and weir.
4 Flow through open orifice
5 Verification of Bernoulli's Equation.
6 Performance characteristics of centrifugal pump.
7 Performance characteristics of submergible pump.
8 Performance characteristics of jet pump.
9 Characteristics of impulse turbine – Pelton wheel turbine.
10 Characteristics of reaction turbine – Francis turbine

REFERENCES:

1. Fluid Mechanics and Machineries Lab Manual, Department of Civil Engineering, 2017

WEBLINKS:

https://www.arborsci.com/cool/fluid-mechanics/

COURSE OUTCOMES	
CO 1	**Observe** the flow characteristics in a pipeline system. **(Imitation)**
CO 2	**Demonstrate** the Bernoulli's Equation. **(Manipulation)**
CO 3	**Conduct** the Performance test of different Pumps and Turbines. **(Precision)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H								H	H				H
	CO2	H								H	H				H
	CO3	H								H	H				H
3	**Category**	**Engineering Science (ES)**													
4	**Approval**	**48th Academic Council Meeting**													

SEMESTER IV

		L	T	P	C
U18BSMA401	**Numerical Methods (Common to B. Tech - Mech, Mechatronics, Automobile, Aero admitted from July 2018)**				
	Total Contact Hours- 60	**3**	**1**	**0**	**4**
	Prerequisite Course – Engineering Mathematics I & II				
	Course Coordinator Name & Department– P. Bhathmanaban& Department of Mathematics				

OBJECTIVE:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT I SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 12

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT II INTERPOLATION 12

Finite differences - Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals- Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both 1/3rd and 3/8th rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods- Taylor series, Euler and modified Euler methods, Runge-Kutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's - Bash forth predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference - solution of 2nd order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for one dimensional wave equation.

TEXTBOOKS:

1. Sastry.SS "Introductory Numerical Methods" 5th edition, PHI, 2012.

2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.
3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005.

REFERENCES:

1. Curtis F. Gerald. "Applied Numerical Analysis", 7th Edition. Pearson Education,
2. Dennis G. Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edition. Jones & Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathi - Numerical methods, S.Chand& Company, 2nd Edition 2010.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_ma14/course

COURSE OUTCOMES (COs)	
CO1	Solve algebraic and transcendental equation using Newton Raphson and regula-Falsi methods and system of linear equations by various methods.
CO2	Apply method of interpolation and extrapolation for numerical data.
CO3	Describe the concept of numerical methods to differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Solve initial value problems of ODE by applying Taylor's series and runge-Kutta methods.
CO5	Analysethe two dimensional Laplace, Poisson equations and one dimensional heat and wave equations of PDE.
CO6	Develop one dimensional and two dimensional problems in engineering field.

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H	H			M							M		
	CO2	H	H	M									M		
	CO3	H	H	M									M		
	CO4	H	H			M							M		
	CO5	H	H										M		
	CO6	H	H	L		L							L		
3	**Category**	Basic Science (BS)													
4	**Approval**	**48th Academic Council Meeting**													

	ELEMENTS OF AEROSPACE STRUCTURES	L	T	P	C
U18PCAS401	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Mechanics and Machines, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the basics of aerospace structures, different types of structural members, their design and analysis.					

UNIT I TRUSSES AND FRAMES 9

Statically determinate frames - Analysis of plane Truss - Method of joints - 3 D Truss-Plane frames - Composite beam.

UNIT II STATICALLY INDETERMINATE BEAMS 9

Propped Cantilever - Fixed-Fixed beams - Clapeyron's Three Moment Equation – moment distribution method.

UNIT III ENERGY METHODS 11

Strain energy evaluation in structural members – Castigliano's Theorem – dummy load & unit load methods – Maxwell's reciprocal theorem – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses

UNIT IV COLUMNS 9

Euler's column curve – inelastic buckling – effect of initial curvature – the Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT V FAILURE THEORY 7

Fail safe and safe life structures, factor of safety, Brief introduction of yield material, brittle vs. ductile behavior, Creep and creep rupture, viscoelastic materials - environmental stress, stress potentials, effect of time and temperature - Fatigue and Fracture - Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.

TEXTBOOKS:

1. "Rajput, R. K.", "A Textbook of Strength of Materials", S Chand Publications, 2018 Edition

REFERENCES:

1. Timoshenko, S., Strength of Materials, Vol. I and II, Princeton D. Von NostrandCo, 1990.
2. Peery, D. J., and Azar J. J., Aircraft Structures, McGraw – Hill (2nd edition), 1999.
3. Bruhn.E.F., Analysis and design of flight vehicle structures,Tri set of offset company, 1973.
4. Michael C.Y.Niu,Airframe structural design (ISBN No.962-7128-04-X), 1998
5. Rivello,Theory and Analysis of Flight Structures, McGraw-Hill, 1969.

WEBLINKS:

https://online.stanford.edu/courses/aa240-analysis-aircraft-structures
https://www.edx.org/course/introduction-to-aerospace-structures-and-materials-0

COURSE OUTCOMES	
CO 1	**Determine** the forces acting in the members of statically determinate truss and frames. (**Apply**)
CO 2	**Calculate** the slope and deflection of statically indeterminate beams. (**Apply**)
CO 3	**Calculate** the deflection and strain energy ofstatically determinate and indeterminate structures. (**Apply**)
CO 4	**Compute** the buckling load and crippling stress of columns with different end conditions. (**Apply**)
CO 5	**Determine** the safe stress of the structural component using failure theories. (**Apply**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H									M				H
	CO2	H											H		H
	CO3	H											H		H
	CO4	H													H
	CO5	H									M				H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS402	AERODYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Mathematics I & II, Fundamentals of Fluid Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the students with the basic concepts necessary to understand the flow around low speed aircrafts, tools to estimate the forces thus generated and methods to design airfoils and wings of an aircraft.

UNIT I BASIC AERODYNAMIC PRINCIPLES 9

Models of fluid - System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity

UNIT II FUNDAMENTALS OF INVISCID FLOWS 9

Elementary Flows and their combinations – Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, KuttaJoukowski Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder

UNIT III AIRFOIL THEORY 9

Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

UNIT IV FINITE WING THEORY 9

Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations, induced drag coefficient, elliptic and general lift distribution, Oswald's wing efficiency factor, effect of plan form and aspect ratio

UNIT V VISCOUS FLOW THEORY 9

Laminar Boundary layer and its thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow

TEXTBOOKS:

1. Anderson, J.D., Fundamentals of Aerodynamics, McGraw Hill Book Co., 2006, Sixth Edition

REFERENCES:

1. Rathakrishnan,E., Theoretical Aerodynamics, John Wiley & Sons, Inc., 2013
2. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
3. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 5th Edition.
4. Clancy L J., Aerodynamics, John Wiley & sons, 1991.

WEBLINKS:

https://www.edx.org/course/introduction-to-aerodynamics

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005/

COURSE OUTCOMES	
CO 1	**Recall** the types of flows based on mathematical equations. (**Understand**)
CO 2	**Solve** flow over basic aerodynamic shapes using concept of inviscid flow theory.(**Apply**)
CO 3	**Determine** the geometric features of airfoils with the help of mathematical transformations. (**Apply**)
CO 4	**Describe** the concept of lift generation and the factors for efficient wing design. (**Understand**)
CO 5	**Determine** the skin friction drag over surfaces. (**Apply**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H									M				H
	CO2	H													H
	CO3	H				L							M		H
	CO4	H											M		H
	CO5	H									M				H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS403	AIRBREATHING PROPULSION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Aero – Thermodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the basics of propulsion, working of different parts of a gas turbine engine, their design and analysis.					

UNIT I FUNDAMENTALS OF ENGINES 7

Gas turbine engine cycle - Engine performance parameters – Efficiencies, Methods of thrust augmentation – Characteristics of propeller, turboprop, turbofan and turbojet engines.

UNIT II INLETS AND NOZZLES 11

Subsonic inlets– External and internal flow pattern – inlet performance criterion –Boundary layer separation – Supersonic inlets – the starting problem – external deceleration– Exhaust nozzles –Theory of flow in isentropic nozzles – Losses in nozzles –Nozzle efficiency— nozzle choking –Over expanded and under expanded nozzles – Ejector and variable area nozzles

UNIT III COMPRESSORS 9

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Concept of pre whirl – Rotation stall – Operating Principle of axial flow compressor – Velocity triangles – degree of reaction – Centrifugal and Axial compressor performance characteristics.

UNIT IV COMBUSTION CHAMBERS 9

Classification of combustion chambers - Combustion process – Stoichiometric Ratio – Equivalence Ratio – Important factors affecting combustion chamber design — Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – flame holders.

UNIT V TURBINES 9

Operating Principle of axial flow turbine – Stator and rotor blades – losses in the blade – choice of blade profile, chord and pitch – stage and overall performance – blade cooling – radial flow turbine.

TEXTBOOKS:

1. Ganesan, V., Gas Turbines, Tata McGraw Hill Publications, Third Edition (Units 1, 3, 4 & 5)
2. Hill, P.G. & Peterson, C.R, Mechanics & Thermodynamics of Propulsion, Addison – Wesley Longman INC, 1999. (Unit 2)

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and SaravanaMuttoo, H.I.H., Gas Turbine Theory, Longman, 1989.
2. Ahmed F. El-Sayed, Aircraft Propulsion and Gas turbine engines, CRS Press, 2008
3. Saeed Farokhi, Aircraft Propulsion, John Wiley & Sons, Inc ., 2009
4. Rolls Royce Jet Engine – 5thEdition – 1996.
5. Oates, G.C., Aero thermodynamics of Aircraft Engine Components, AIAA Education Series.

WEBLINKS:
https://freevideolectures.com/course/3008/jet-aircraft-propulsion
https://cosmolearning.org/courses/introduction-jet-propulson/

COURSE OUTCOMES	
CO 1	**Compare** the performance characteristics of turbojet, turbofan, turboprop and propeller engines. **(Understand)**
CO 2	**Identify** the engine starting problems associated with inlets. **(Understand)**
CO 3	**Discuss** the types of nozzles and the losses in nozzles. (**Understand**)
CO 4	**Explain** the working principle of axial and centrifugal flow compressors. **(Understand)**
CO 5	**Discuss** important factors affecting combustion chamber design and the problems associated with flame stabilization. (**Understand**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													H
	CO2	H									M				H
	CO3	H											H		H
	CO4	H									M		H		H
	CO5	H											H		H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS404	AEROSPACE MATERIALS	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce to the students about the importance of materials in the design of the aircraft					

UNIT I INTRODUCTION 9

Properties of Flight Vehicle Materials, Importance of strength to weight ratio and change in properties with respect to temperature variations, factors affecting choice of material for different parts of airplane, Structure of solid materials - crystal structure, effect of crystal imperfections on mechanical properties

UNIT II ALLOYS FOR AIRCRAFT APPLICATIONS 9

Aluminum alloys, High strength and corrosion resistance alloys. Magnesium alloys and their properties, Carbon Steels and Steel Alloys, Effect of alloying elements, Applications of these alloys to aircrafts.

UNIT III HIGH STRENGTH AND HEAT RESISTANT ALLOYS 9

Classification of heat resistant materials, Iron, Nickel and Cobalt base alloys, Refractory materials, Ceramics, Titanium and its alloys, properties of Inconel, Monel& K-Monel, Nimonic and Super Alloys – Applicationsto Aircrafts

UNIT IV HEAT TREATMENT AND CORROSION RESISTANCE 9

Heat treatment of carbon steel, aluminium alloys, magnesium alloys and titanium alloys used in aircraft. Types of corrosions - Effect of corrosion on mechanical properties - Protection against corrosion - Corrosion resistant materials used in aerospace vehicles.

UNIT V MODERN MATERIALS 9

Significance of Composites and Nanomaterials in Aerospace Engineering, Introduction to graphene, spider silk, silica aerogel, shrilk, stanene and metamaterials and their applications.

TEXTBOOKS:

1. Aircraft Material and Processes: G F Titterton, 5th Edition, Himalayan Books, New Delhi.

REFERENCES:

1. Martin, J.W., "Engineering Materials, Their Properties, and Applications ",Wykedham Publications (London) Ltd., 1987.
2. Titterton, G., "Aircraft Materials and Processes ", V Edition, Pitman Publishing Co., 1995.
3. Krishnadas Nair, C.G., "Handbook of Aircraft Materials ", Interline Publishing, 1993.
4. Balram Gupta, "Aerospace Materials ", Vol. I, Vol. II and Vol. III, S. Chand &Company Ltd., New Delhi -1996.
5. Thiruvadigal, J.D., Ponnusamy,S. and Vasuhi.P.S., Materials Science 5thedition, Vibrant Publications, Chennai, 2007.

WEBLINKS:

https://www.edx.org/course/introduction-to-aerospace-structures-and-materials-0

COURSE OUTCOMES	
CO 1	**Explain** mechanical properties of aircraft structural materials. (Understand)
CO 2	**Classify** different types of alloys and discuss their effects on corrosion resistance. (Understand)
CO 3	**Compare** properties of alloys in high temperature applications. (Anlayze)
CO 4	**Describe** the heat treatment processes of alloys and methods to prevent corrosion. (Understand)
CO 5	**Summarize** the application of advanced materials in aerospace engineering. (Understand)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H						M							H
	CO2	H						M							H
	CO3	H						M							H
	CO4	M						M			H				H
	CO5	M						M			H				H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS405	MANUFACTURING TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Engineering Graphics & Design				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To help the student to understand about the different types of manufacturing processes and the uniqueness of different methods.					

UNIT I METAL WORKING PROCESS 5

Mechanical working of metals –hot and cold working –rolling, extrusion, spinning, wire-drawing, press working. Welding – different types of gas and arc welding process, soldering and brazing. Casting –different types, furnaces

UNIT II MACHINING PROCESSES 7

Lathe – introduction, types, construction, mechanisms and attachments for various operations, nomenclature of single point cutting tool. Capstan and turret lathes various mechanisms, tool and loading arrangement. Automatic lathes - single spindle and multi spindle mechanisms, Introduction to CNC machining

UNIT III SHAPER, PLANER AND MILLING PROCESSES 7

Shaper, planer and slotter: types, specifications, mechanisms, holding devices, difference between shaper and planer. Milling machine – types and specification, mechanisms, holding devices, milling operations.

UNIT IV DRILLING, BORING, BROACHING, SURFACE FINISHING PROCESSES 6

Drilling, Boring- Specification, Nomenclature of drilling and reaming tool and its specification. Broaching: Specification, types, mechanisms, nomenclature of broaching tool. Grinding process, Types of grinding machines, Grinding Wheels, Honing, Super finishing, Polishing, Metal spraying, Galvanizing, Electroplating.

UNIT V NON – TRADITIONAL MACHINING PROCESSES 5

Non-traditional machining techniques, classification, Abrasive jet machining, Electrical Discharge Machining, E. D wire cutting, Electro chemical machining, Electron Beam Machining, Laser Beam Machining, Ultrasonic Machining – Introduction to 3D Printing

TEXTBOOKS:

1. HajraChowdary S.K, The fundamentals of work shop technology Vol. I & II, Media publishers, 1997.

REFERENCES:

1. W.A.J. Chapman., Workshop Technology. Vol I, II& III, 1975, ELBS.
2. Roy A Lindberg, Process and Material Manufacture, PHI, 1995.
3. Kalpakjan, Manufacturing Engineering and Technology, Addison Wesley, 2005.
4. P.C. Sharma., A text book of Production Technology, S.Chand& Company ltd, 2007.
5. P.N.Rao. Manufacturing Technology-Foundry Forging and Welding, TMH publishing co, 2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_me03
https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x-0

COURSE OUTCOMES	
CO 1	**Describe** various metal forming process and different types of welding. (**Understand**)
CO 2	**Describe** types of lathe and their construction. (**Understand**)
CO 3	**Explain** the process of shaping, planing and milling operations. (**Understand**)
CO 4	**Discuss** the process involved in drilling, boring, broaching, surface finishing. (**Understand**)
CO 5	**Describe** the working principle of various Non-traditional machining techniques. (**Understand**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													
	CO2	H										L			
	CO3	H													
	CO4	H									L				
	CO5	H									L				
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS4L1	AERODYNAMICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Fundamentals of Fluid Mechanics, Co-requisite – Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To give to the student a practical experience of using the subsonic wind tunnel to carry out experimentation on different design models and to calculate forces acting on the models based on the experimentation.

LIST OF EXPERIMENTS

1 Calibration of subsonic wind tunnel.
2 Pressure distribution over smooth cylinder
3 Pressure distribution over rough cylinder.
4 Pressure distribution over symmetric airfoil.
5 Pressure distribution over cambered airfoil.
6 Pressure distribution over a wing
7 Force measurement on an Airfoil using wind tunnel balance.
8 Pressure distribution over a building model.
9 Aerodynamic studies of automotive models.
10 Flow visualization at subsonic velocity using (a) Smoke (b) Oil.

REFERENCES:

1. Aerodynamics Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=IdES9fdUh2c
https://www.youtube.com/watch?v=E9ZSAX56m0E
https://www.youtube.com/watch?v=UqBmdZ-BNig

COURSE OUTCOMES	
CO 1	**Carryout** flow analysis over various aerodynamic models. (**Imitation**)
CO 2	**Demonstrate** the usage of mechanical and electronic instruments in data acquisition. (**Manipulation**)
CO 3	**Conduct** experiments at various orientation of models to characterize the flow. (**Articulation**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H								H	H				H
	CO2	H								H	H				H
	CO3	H								H	H		M		H
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18PCAS4L2	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Nil, Co-requisite – Manufacturing Technology				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the knowledge and practical experience of operating various manufacturing machines like lathes, milling machines, shaper, planer

LIST OF EXPERIMENTS

1 Study of centre, capstan and automatic lathes and their accessories.
2 Exercise on setting the work piece and the tool in the lathe.
3 Plane turning and step turning.
4 Taper turning and knurling.
5 Eccentric Turning.
6 Thread cutting and grooving.
7 Drilling and reaming.
8 Drilling and boring.
9 Surface grinding
10 Study of milling and grinding machines.

REFERENCES:

1. Machine Shop Lab Manual, Department of Mechanical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=8EsAxOnzEms
http://www.sme.org/fmp/
https://www.youtube.com/watch?v=-9fLQ9NHc4g

COURSE OUTCOMES	
CO 1	**Carry out** different machining operations on center lathe **(Imitation)**
CO 2	**Perform** drilling, reaming and boring processes. **(Precision)**
CO 3	**Observe** the working of Planner shaper miller and grinder. **(Imitation)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H								H	H		H		
	CO2	H								H	H		H		
	CO3	H								H	H		H		
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18PCAS4L3	INTRODUCTION TO MATLAB	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Mathematics I & II				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint with the MATLAB application to solve various engineering problems.

LIST OF EXPERIMENTS

1 Introduction to MATLAB
2 Relational and Logical Expressions in MATLAB
3 Working with Matrices
4 Plotting using MATLAB
5 Exercise on Curve Fitting
6 Exercise on Complex and Statistical Analysis
7 Program Flow Control in MATLAB
8 Input and Output of Variables
9 Exercise on solving ODE's and PDE's
10 Exercise on using SIMULINK for dynamic simulation.

REFERENCES:

1. MATLAB Lab Manual, Department of Aeronautical Engineering, 2018.

WEBLINKS:

https://www.mathworks.com/support/learn-with-matlab-tutorials.html

COURSE OUTCOMES	
CO 1	**Master** thebasic computing and programming features of MATLAB **(Precision).**
CO 2	**Perform** data plotting, curve fitting and statistical analysisin MATLAB**(Precision).**
CO 3	**Adapt**MATLAB to solve engineering-related problems using numerical methods and in performing dynamic simulation **(Articulation).**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H				H									
	CO2	H				H								H	H
	CO3	H				H								H	H
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

SEMESTER V

U18PCAS501	AEROSPACE STRUCTURAL MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the knowledge about the mechanics of different aircraft structural members, and their design.

UNIT I UNSYMMETRICAL BENDING 9

Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method- advantages and disadvantages.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9

Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9

Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear center of closed sections.

UNIT IV BUCKLING OF PLATES 9

Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength by Needham's and Gerard's methods – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width – inter-rivet and sheet wrinkling failures - short panel failing strength.

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE 9

Wing structural arrangements – factors influencing - wing stress analysis methods – determination of shear force and bending moment distribution over fuselage – Numerical problems – Tension field beam – general Wagner equation - Semi-tension field beams.

TEXTBOOKS:

1. Megson T M G, 'Aircraft Structures for Engineering Students', Fifth Edition, Elsevier Aerospace Engineering Series,2007. (Units 1, 2, 3 & 5)
2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999 (Unit 4)

REFERENCES:

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997
3. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985

WEBLINKS:

https://www.sciencedirect.com/topics/engineering/shear-centre

http://nptel.ac.in/courses/105106049/63
https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-21-techniques-for-structural-analysis-and-design-spring-2005/

COURSE OUTCOMES	
CO 1	**Compute** the bending stress distribution in beams of symmetric and unsymmetrical sections. (**Apply**)
CO 2	**Calculate** the shear flow distribution in symmetrical and unsymmetrical thin-walled open section and its shear center. (**Apply**)
CO 3	**Calculate** the shear flow distribution in thin walled single and multi-cell structures subjected to combined loading. (**Apply**)
CO 4	**Compute** the crippling strength of thin plates and effective width of sheet stiffener panels. (**Apply**)
CO 5	**Analyze** the stress developed in aircraft wings and fuselage. (**Analyze**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H									H				H
	CO2	H									H				H
	CO3	H									H				H
	CO4	H													H
	CO5	H													H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS502	COMPRESSIBLE FLOW	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To make the student understand about the flow physics of high speed gases, shocks and high speed vehicles and experimentation techniques.

(Use of Gas Tables is permitted)

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 9

Compressibility, Continuity, Momentum and Energy equation for steady one dimensional flow, Compressible Bernoulli's equation, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Isentropic relations - Critical conditions, Characteristic Mach number, Maximum discharge velocity.

UNIT II SHOCKS AND EXPANSION WAVES 10

Normal shock relations, Prandtl's relation, Hugonoit equation, Rayleigh Supersonic Pitot tube equation, Oblique shocks, θβM relation, Shock Polar, Reflection of oblique shocks, Left running and Right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, Operating characteristics of convergent and convergent-divergent nozzles.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW 10

Potential equation for 2-dimensional compressible flow, Linearization of potential equation,Small perturbation theory, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics, Wave drag coefficient.

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION 8

Critical Mach number, Drag divergence Mach number, Shock Stall, Shock- Boundary layer interaction, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings.

UNIT V EXPERIMENTAL METHODS 8

Wind tunnels for Subsonic, transonic, Supersonic and hypersonic flows, Various Measurement techniques – velocity, pressure, Flow visualization techniques in high speed flows, Shock tube, Gun tunnels

TEXTBOOKS:

1. Rathakrishnan.. E, Gas Dynamics, Prentice Hall of India, Sixth Edition, 2017.

REFERENCES:

1. Anderson, J. D, Modern Compressible Flow, Third Edition, Tata McGraw-Hill & Co., 2012.
2. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
3. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989.

4. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 19976.
5. Yahya S.M., Fundamentals of Compressible Flows, Third Edition, New Age International Publishers, 2003.

WEBLINKS:
https://onlinecourses.nptel.ac.in/noc17_ae05/course

COURSE OUTCOMES	
CO 1	**Apply** the concepts of isentropic flow for problems related to variable area ducts. (**Apply**)
CO 2	**Calculate** the properties of flow through shock and expansion waves. (**Apply**)
CO 3	**Determine** the aerodynamic coefficients of compressible flows based on linearized flow theory. (**Apply**)
CO 4	**Categorize** various aircrafts intended for subsonic and supersonic regimes based on wing and fuselage design. (**Analyze**)
CO 5	**Describe** flow measurement and visualization techniques for high-speed flows. **(Understand)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H											H		H
	CO2	H											H		H
	CO3	H		L							L		H		H
	CO4	H				M					L		H		H
	CO5	H				M							H		H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS503	ROCKET PROPULSION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Airbreathing Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the rocket engines, electric engines, components and functions.					

UNIT I THEORY OF ROCKET PROPULSION 8

Brief History – Classification – Rocket Principle and Rocket Equation – Mass Ratio – Specific Impulse – Desirable Parameters of Rockets – Propulsive Efficiency – Performance Parameters – Staging and Clustering of Rockets – Statics Testing of Rockets

UNIT II SOLID PROPELLANT ROCKETS 9

Operating principle – Specific impulse of a rocket – Igniters – Internal ballistics – Selection criteria of solid propellants – propellant grain design considerations – Progressive, Regressive and neutral burning in solid rockets.

UNIT III LIQUID PROPELLANT ROCKETS 10

Liquid propellant rockets – selection of liquid propellants – performance and choice of various feed systems for liquid propellant rockets – hydrazine monopropellant rockets–basics of cryogenic techniques – Cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets –draining of propellant tanks under microgravity conditions

UNIT IV MODERN PROPULSION TECHNIQUES 8

Hybrid Rockets, Burning Mechanism, Advantages of Hybrid Rockets over Solid and Liquid Propellant Rockets – Nuclear Rockets – Pulse Detonation Rockets – Beamed Rockets and Sail Propulsion – Basics of Electrothermal, Electrostatic and Electromagnetic Thrusters

UNIT V ROCKET NOZZLE AND PERFORMANCE 10

Nozzle types – Effect of Shape and Area Ratio – Performance Losses, Flow Separation in Nozzles – Mass Flow Rate and Characteristic Velocity – Thrust Coefficient – Bell Nozzle – Unconventional Nozzles, SERN nozzle – Aerospike nozzle, annular nozzles.

TEXTBOOKS:

1. Ramamurthi, K., “Rocket Propulsion”, Trinity Press, First Edition, 2010

REFERENCES:

1. 2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 8th Edition, 2010.
2. J D Mattingly, “Elements of Propulsion - Gas Turbines and Rockets “, AIAA Education Series, 2006.
3. Thomas A Ward, “Aerospace Propulsion Systems”, John Wiley & Sons Inc., New York,2010.
4. DanM.Goebel, Ira Katz, ‘Fundamentals of Electric Propulsion’, John Wiley & Sons Inc, New York, 2003.

WEBLINKS:

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-512-rocket-propulsion-fall-2005/

COURSE OUTCOMES	
CO 1	Analyze the propulsion system with performance parameters
CO 2	Describe performance parameters used in solid rocket motor engines
CO 3	Explain the fundamental concept of a liquid rocket engine performance
CO 4	Comprehend and illustrate the basics of hybrid, nuclear rockets in terms of their designing approach
CO 5	Relate the significance of nozzle design.

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													H
	CO2	H													H
	CO3	H									H				H
	CO4	H									H				H
	CO5	H													H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS504	AIRCRAFT PERFORMANCE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

UNIT I AERODYNAMICS OF THE AIRPLANE 10

International Standard Atmosphere, TAS, IAS and EAS, , Aerodynamic Lift, Drag and Moments – Lift, Drag and Moment Co-efficient- Aerodynamic Center – NACA airfoil nomenclature – Streamlined and Bluff body – Skin friction Drag, Pressure Drag and Induced Drag – Drag Polar – Various drags of an airplane – Methods of Drag Reduction – Mach Number – Effect on Drag Polar.

UNIT II AIRCRAFT ENGINE PERFORMANCE 10

Power available and power required curves- Thrust available and thrust required curves- Conditions for power required and thrust required minimum-Thrust available and maximum velocity, Power available and maximum velocity-Altitude effects on power available and power required-thrust available and thrust required-Effect of drag divergence on maximum velocity.

UNIT III STEADY LEVEL FLIGHT 10

Steady level flight, the fundamental Parameters: Thrust – to – weight ratio, Wing loading, Drag polar, and lift-to – drag ratio. Aerodynamic relations associated with lift-to-drag ratio, Range and Endurance of Propeller and Jet aircrafts

UNIT IV GLIDING AND CLIMBING FLIGHT 8

Equation of motion for Rate of climb- Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- , Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V ACCELERATED FLIGHT 7

Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, bank angle and load factor, Constraints on load factor, Pull up and pull down maneuvers, V-n diagram.

TEXTBOOKS:

1. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 2010.

REFERENCES:

1. MiadoSaarlas, Aircraft Performance, John Wiley & Sons, 2007
2. Torenbeek E and Wittenberg H, Flight Physics, Springer, 2009
3. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999.
4. Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004
5. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Amold Publishers, 1988

WEBLINKS:

https://swayam.gov.in/course/1316-introduction-to-airplane-performance

COURSE OUTCOMES	
CO 1	**Describe** basic principles relating to drag polar equation of the aircraft. (**Understand**)
CO 2	**Examine** the aircraft engine performance. (**Apply**)
CO 3	**Calculate** range and endurance for power and thrust producing engine under various flight conditions. (**Apply**)
CO 4	**Examine** climb and glide performance for shallow and steep angles. (**Apply**)
CO 5	**Calculate** take off, landing and turning performance under various flight conditions. (**Apply**)

CO / PO MAPPING

L –LOW, M – MEDIUM, H – HIGH

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO 1	H												H		
CO 2	H												H	H	
CO 3	H												H	H	
CO 4	H									M			H		
CO 5	H									M			H		
Category	**Professional Core (PC)**														
Approval	**48th Academic Council Meeting**														

U18PCAS505	AIRCRAFT STABILITY AND CONTROL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 12

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing

UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 11

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery

UNIT III STATIC LATERAL STABILITY AND CONTROL 8

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

UNIT IV DYNAMIC LONGITUDINAL STABILITY 8

Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 6

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

TEXTBOOKS:

1. Nelson, R.C. "Flight Stability & Automatic Control", McGraw Hill, 1998.

REFERENCES:

1. McCormick, B.W. "Aerodynamics, Aeronautics & Flight Mechanics", John Wiley, 1995.
2. Babister, A.W. "Aircraft Stability and response", Pergamon Press, 1996.
3. Etkin, B., "Dynamics of Flight Stability and Control", John Wiley, New York, 1982.

4. Perkins C.D. &Hage R.E. “Airplane performance, stability and control”, John Wiley & Sons 1976.
5. Pamadi, B.N.,”Performance, Stability, Dynamics, and Control of Airplanes”, AIAA Education Series, 2004

WEBLINKS:
https://nptel.ac.in/courses/101104062/10

COURSE OUTCOMES	
CO 1	**Describe** criteria of static longitudinal stability under stick fixed and stick free conditions. (**Understand**)
CO 2	**Estimate** the contribution of aircraft components on static directional stability and the rudder effectiveness for different flight conditions. (**Apply**)
CO 3	**Estimate** the contribution of aircraft components on static lateral stability and compute the effectiveness of aileron. (**Apply**)
CO 4	**Estimate** dynamic longitudinal stability derivatives under non equilibriumconditions of aircraft. (**Apply**)
CO 5	**Compute** the stability derivatives for lateral and directional dynamics of aircraft. (**Apply**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H													M
	CO2	H													M
	CO3	H													M
	CO4	H									M				M
	CO5	H									M				M
3	**Category**		**Professional Core (PC)**												
4	**Approval**		**48th Academic Council Meeting**												

U18PCAS5L1	**AIRCRAFT STRUCTURES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**4**	**2**
	Prerequisite – Elements of Aerospace Structures, Co-requisite – Aircraft Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the structural analysis of different aircraft parts, shear centers, combined loading					

LIST OF EXPERIMENTS

1 Verification of Maxwell's theorem and principle of superposition.
2 Column – Testing.
3 Testing of riveted joints.
4 Unsymmetrical Bending of a Beam
5 Determination of Shear Centre in open Section
6 Determination of Shear Centre in closed Section
7 Combined bending and Torsion of a Hollow Circular Tube
8 Constant Strength Beams
9 Wagner beam – Tension field beam
10 Material properties test of composite laminate

REFERENCES:

1. Aircraft Structures Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=Na7vONvHqOc
https://www.youtube.com/watch?v=SH_NlsDe3jE
https://www.youtube.com/watch?v=EEQqmYPOLIQ

COURSE OUTCOMES	
CO 1	**Demonstrate** structural mechanics principles/phenomenon using simple experiments. **(Manipulation)**
CO 2	**Observe** deformation of structural members or/and failure of materials under given loads. **(Imitation)**
CO 3	**Perform** comparative study between the obtained experimental results and theoretical values.**(Precision)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H								H	H				H
	CO2	H								H	H				H
	CO3	H								H	H				H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS5L2	GAS DYNAMICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the student to the various experimental processes in supersonic flows

LIST OF EXPERIMENTS

1 Supersonic wind tunnel, components, operation and precautions
2 Measurements in supersonic wind tunnel
3 study of data acquisition systems and pressure sensors
4 Calibration of supersonic wind tunnel
5 Exercise on setting up the shadowgraph system
6 Pressure distribution over a wedge model
7 Flow visualization of w edge model using shadowgraph
8 Pressure distribution over a blunt protrusion
9 Flow visualization of blunt protrusion using shadowgraph
10 Flow visualization of a missile .

REFERENCES:

1. Gas Dynamics Lab Manual, Department of Aeronautical Engineering, 2018

WEBLINKS:

https://nptel.ac.in/courses/112103021/

COURSE OUTCOMES	
CO 1	Carry out experimentation on high speed flows.
CO 2	Conduct pressure distribution experiments on models
CO 3	Demonstrate optical flow visualization pattern over the models

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H				H				H	H				H
	CO2	H				H				M	M				H
	CO3	H				H				M	M				H
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18PCAE5L3	FLIGHT SIMULATION LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Fundamentals of Aeronautics and Astronautics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint with the basic starting and operation of a Cessna 172 aircraft through a flight simulator					

LIST OF EXPERIMENTS

1 Specification of Cessna C-172 –S
2 Cessna-172 Trainer Aircraft Operational Check
3 Study of Cessna – 172 Flight Simulators
4 Demonstrate the Autopilot Mode and Automatic Direction Control Mode of Cessna 172 Trainer Aircraft
5 Demonstration of Takeoff And Landing in Cessna-127 Trainer Aircraft using Flight Simulator
6 Demonstration of Basic Aircraft Instruments
7 Study of Ring Laser Gyro
8 Study of Fly-By-Wire And Fly-By-Light
9 Demonstration of Lateral Autopilot
10 Demonstration of Longitudinal Autopilot

REFERENCES:

1. Flight Simulation Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.digitaltrends.com/gaming/best-free-flight-simulators/

COURSE OUTCOMES	
CO 1	**Recognize**features of theflight simulator and observe basic operational procedure (pre-takeoff, takeoff and landing) for flying Cessna – 172 aircraft **(Understand).**
CO 2	**Identify** the basic aircraft instruments and their application during takeoff and landing **(Understand).**
CO 3	**Demonstrate** takeoff, autopilot and landing Cessna-172 **(Understand).**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1													L	
	CO2													L	L
	CO3													L	L
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

SEMESTER VI

U18HSBA601	Organizational Behavior	L	T	P	C
	Total No. of contact hours: 45	3	0	0	3
	Pre-requisite: Nil				
	Course Designed by: Dept of Management Studies				

Course Objectives

1. Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups
4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
5. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

UNIT I **9 hours**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9 hours**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9 hours**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9 hours**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9 hours**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

COURSE OUTCOMES (COs)	
CO1	**Identify** the frame work of Organizational Behaviour.**(Remember)**
CO2	**Infer** concepts of Interpersonal perception. **(Understand)**
CO3	**Compare** the Merits and Demerits of Group decision making.**(Understand)**

CO4	**Describe** the approach of leadership and Summarize the Sources of power.**(Remember)**
CO5	**Relate** change, conflict and culture of management. **(Understand)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1					H	H	H							
	CO2					H	H	H							
	CO3					H	H	H							
	CO4					H	H	H							
	CO5					H	H	H							
3	**Category**	**Humanities and Sciences (HS)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS601	FINITE ELEMENT ANALYSIS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the student with basic numerical techniques called finite element techniques to analyze structural components.

UNIT I INTRODUCTION 9

Introduction to FEA - historical background - Review of various approximate methods – Rayleigh Ritz method, Weighted residual methods - Convergence criteria - Fundamentals of Finite Element Modeling – Element Division - Numbering Scheme - Examples of Finite Element Modeling

UNIT II ONE DIMENSIONAL SYSTEMS 9

Direct stiffness method – spring element- Derivation of the stiffness matrix- Example of a spring assemblage-Assembly of global stiffness matrix-Types of boundary conditions- The Potential energy approach –Examples- bar element – Coordinate systems and Shape Functions- The Potential Energy Approach- Assembly of Global Stiffness Matrix and Load Vector - Boundary Conditions- Temperature Effects – Heat transfer problems in 1D bar and wall

UNIT III TWO DIMENSIONAL SYSTEMS 9

Beam element – element stiffness – load vector – global stiffness matrix – boundary conditions – solution, Plane truss structure - Coordinate Transformation – Local & Global Coordinate- The Element Stiffness Matrix- Stress Calculations- Temperature Effects – Examples.Plane stress & strain – Constant Strain Triangle (CST)- Potential Energy Approach - Element Stiffness; Force Terms, Stress Calculations- Temperature Effects- Examples

UNIT IV THREE DIMENSIONAL SYSTEMS 9

Axisymmetric formulation – Element stiffness matrix and force vector – Body forces and temperature effects – Stress calculations – Boundary conditions and Nodal Solution; Mapping and Numerical Integration—Applications to cylinders under internal or external pressures – Rotating discs - Isoparametric Representation- Four noded quadrilateral for axisymmetric problems

UNIT V APPLICATIONS OF FEM TO AEROSPACE STRUCTURES 9

Linear static analysis-non linear static analysis –dynamic analysis-simple harmonic motion-damping consideration-forced vibration -Case studies and problems using software packages and programming.

TEXTBOOKS:

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu", Introduction to Finite Elements in Engineering", Prentice Hall India,Fourth Edition, 2011.

REFERENCES:

1. Reddy J.N.,"An Introduction to Finite Element Method ",McGraw Hill , 3rd edition, 2005.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2nd 2001.

3. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
4. Rao. S.S., "Finite Element Methods in Engineering", Butterworth and Heinemann, Fourth Edition, 2005.
5. Daryl L. Logan, "A First Course in the Finite Element Method", 5th Edition, PWS Publishing Company, Boston, 2010.

WEBLINKS:
https://nptel.ac.in/courses/112104116/

COURSE OUTCOMES	
CO 1	**Compare** various functional approximation methods for structural problems. (**Analyze**)
CO 2	**Calculate** the nodal field variables for one dimensional structure. (**Apply**)
CO 3	**Determine** the stiffness matrix and stress developed in two dimensional structures. (**Apply**)
CO 4	**Calculate** the nodal displacements and stress for axi-symmetric structures. (**Apply**)
CO 5	**Analyze t**he static and dynamic behavior of structures. (**Analyze**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H									M				H
	CO2	H											M		H
	CO3	H											M		H
	CO4	H									M				H
	CO5	H				L									H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

	HEAT TRANSFER	L	T	P	C
U18PCAS602	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Aero – Thermodynamics, Fluid Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To familiarize the student with the various modes of heat transfer, estimation of heat transfer parameters and design of heat transfer devices, insulators and heat shields.

(Use of Heat and Mass Transfer Data Book is permitted)

UNIT I CONDUCTION HEAT TRANSFER – STEADY STATE 7

Modes of heat transfer: One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces.

UNIT II CONDUCTION HEAT TRANSFER – TRANSIENT 10

Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Transient Heat Transfer – Temperature charts

UNIT III CONVECTIVE HEAT TRANSFER 8

Introduction – Free convection in atmosphere - free convection on a vertical flat plate – Empirical relation in free convection – Forced convection – Laminar and turbulent - convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations.

UNIT IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS 10

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces – Radiation between surfaces-Radiation shape factors-Radiation shields.

Types of heat exchangers -overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 10

Heat transfer problems in gas turbine engines, rocket nozzles and re-entry vehicles – Numerical techniques to solve heat transfer problems in aerospace engineering –numerical problems using software and programming.

TEXTBOOKS:

1. Sachdeva, S.C. “Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd. Fourth Edition, New Delhi, 2012. (Units 1 to 4)
2. Sunden B, Juan Fu, “Heat Transfer in Aerospace Applications”, Academic Press, First Edition, 2016 (Unit 5)

REFERENCES:

1. Sutton, G.P., "Rocket Propulsion Elements ", John Wiley and Sons, 8th Edition.2010.
2. Lienhard J. H., “A Heat Transfer Text Book”, Phlogiston Press, U.S.A., 2008.
3. Ozisik M.N., “Heat Transfer A Basic Approach”, The McGraw-Hill Company, reprint 1995.
4. Holman, J.P., "Heat Transfer ", McGraw Hill Book Co., Inc., New York, TenthEdition.,2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_ch08/course

COURSE OUTCOMES	
CO 1	Students will be able to calculate heat transfer rate through plane wall, cylinder and sphere
CO 2	Student will be able to solve problem involving unsteady heat transfer by conduction
CO 3	Students will be able to design and analysis system involving convective heat transfer
CO 4	Student will be able to calculate the amount of heat transfer by radiation
CO 5	Student will be able to solve the heat transfer problem in gas turbine, reentry vehicle

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	L	M	L	L	M	L							M	
	CO2	L	M	M	L	H									
	CO3	L	M	M	L	H								M	
	CO4	L	M	M	L	H									
	CO5	L	L	M	L	H	L							M	
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS6L1	COMPUTER AIDED ANALYSIS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Elements of Aerospace Structures, Low Speed Aerodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with various computer software for engineering analysis					

LIST OF EXPERIMENTS

1 Study of commercial software packages and their tools
2 Stress analysis of beams with different loading conditions
3 Stress analysis of a plate with circular hole
4 Stress analysis of an axisymmetric component
5 Vibration analysis of cantilever beam
6 Simple conduction example
7 Thermal mixed boundary example
8 Flow field analysis of jets
9 Flow field simulation over an airfoil
10 Fluid – Structure interaction

REFERENCES:

1. CAA Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.ansys.com/en-in/academic/free-student-products/support-resources

COURSE OUTCOMES	
CO 1	**Carry out** elementary mechanical coupon testing of materials as per the given procedure**. (Imitation)**
CO 2	**Acquire** data using the available measuring devices. **(Manipulation)**
CO 3	**Perform** basic mathematical calculation using the appropriate formulae and represent the results in form of graph and table**.(Precision)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H				H				H	H		H		H
	CO2	H				H				H	H		H		H
	CO3	H	L			H				H	H		H	H	
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18PCAS6L2	PROPULSION LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Low Speed Aerodynamics, Aircraft Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To give an experience on experimentation with fluid jets, combustion and heat transfer.					

LIST OF EXPERIMENTS

1 Estimation of spread rate in incompressible circular jets.
2 Estimation of spread rate in incompressible non- circular jets.
3 Estimation of centre line velocity decay in supersonic circular jets.
4 Estimation of centre line velocity decay in supersonic non-circular jets.
5 Determination of Wall jet velocity profile.
6 Supersonic Jet Pattern Analysis using Schlieren Technique.
7 Study of free convective heat transfer over a flat plate.
8 Study of forced convective heat transfer over a flat plate.
9 Operation of a subsonic Ramjet engine.
10 Determine the calorific value of Fuel using Bomb Calorimeter.

REFERENCES:

1. Propulsion Lab Manual, Department of Aeronautical Engineering, 2017

WEBLINKS:

https://www.youtube.com/watch?v=PxYfyUNQi5k
https://www.youtube.com/watch?v=27IsaLGoRBE

COURSE OUTCOMES	
CO 1	**Demonstrate** the various procedures and techniques for the experiments. (**Manipulation**)
CO 2	**Observe** the data using the different measuring devices and techniques. (**Imitation**)
CO 3	**Follow** the mathematical concepts/equations to obtain quantitative results. (**Imitation**)

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H								H	H		M		M
	CO2	H								H	H		M		M
	CO3	H								H	H				M
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18EEAS6L1	AIRCRAFT DESIGN PROJECT	L	T	P	C
	Total Contact Hours – 45	0	0	6	3
	Prerequisite – Flight Mechanics, Engineering Graphics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to carry out a preliminary design of an aircraft.					

LIST OF EXPERIMENTS

1 Comparative configuration study of different types of airplanes
2 Comparative study on specification and performance details of aircraft
3 Preparation of comparative data sheets
4 Selection of main parameters for the design
5 Preliminary and Secondary weight estimations.
6 Power plant selection and airfoil selection
7 Estimation of Drag Polar
8 Performance calculations and stability estimates
9 V – n diagram
10 Critical loading performance and final V – n graph calculation
11 Structural Design Study
12 Load estimation of wings and fuselage
13 Design of components of wings and fuselage
14 Balancing and maneuvering loads
15 Preparation of layouts of balance diagram and three view drawings

REFERENCES:

1. Aircraft Design Project Reference Guide, "E. Tulapurkara", NPTEL, 2017
2. Aircraft Performance and Design, "John D Anderson", Tata McGraw Hill Publications
3. Nelson, R.C." Flight Stability & Automatic Control", McGraw Hill, 1998.
4. Analysis and Design of Flight Vehicle Structures, E F Bruhn

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc17_ae08/

COURSE OUTCOMES	
CO 1	Observe the design parameters of different airplane configurations
CO 2	Carryout weight estimation and performance parameter calculations
CO 3	Design structural components of the aircraft

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H	H	M						H	H		H		H
	CO2	H	H	H						H	H		H		H
	CO3	H	H	H		L				H	H		H		H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

SEMESTER VII

	GUIDANCE AND CONTROL	L	T	P	C
U18PCAS701	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electricals and Electronics, Aircraft Stability and Control				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To provide the students the basic knowledge of guidance and control					

UNIT I INTRODUCTION **4**

Introduction to Guidance and control - Definition, Historical background.

UNIT II AUGMENTATION SYSTEMS **7**

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT **12**

Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNIT IV LATERAL AUTOPILOT **10**

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE **12**

Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes.

TEXTBOOKS:

1. Blake Lock, J.H “Automatic control of Aircraft and missiles” John Wiley Sons, New York, 1990.

REFERENCES:

1. Stevens B.L & Lewis F.L, “Aircraft control & simulation”‘, John Wiley Sons, New York, 1992.
2. Collinson R.P.G, “Introduction to Avionics”, Chapman and Hall, India, 1996.
3. Garnel.P. &East.D.J, “Guided Weapon control systems”, Pergamon Press, Oxford, 1977.
4. Nelson R.C “Flight stability & Automatic Control”, McGraw Hill, 1989.
5. BernadEtikin, ”Dynamic of flight stability and control”, John Wiley, 1972.
6. Jan Roskam, “Airplane Performance, Stability and Control”, DAR Corporation, 1997.

WEBLINKS:

https://freevideolectures.com/course/2303/aircraft-systems-engineering/16
https://pe.gatech.edu/courses/guidance-navigation-and-control-theory-and-applications

COURSE OUTCOMES

CO 1	**Explain** the equations governing the aircraft dynamics and the process of liberalizing them.
CO 2	**Discuss** the guidance schemes and requirements for aircrafts and missiles
CO 3	**Apply** the principle of stability and control augmentation systems.
CO 4	**Analyze** the oscillatory modes and methods of suppressing them
CO 5	**Design** the controller for lateral, longitudinal and directional control of aircrafts.

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H												H	H
	CO2	H									M			H	H
	CO3	H											M	H	H
	CO4	H				M								H	H
	CO5	H	L	L		M	L				M		M	H	H
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

	SATELLITE TECHNOLOGY	L	T	P	C
U18PCAS702	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electricals and Electronics, Applied Dynamics and Vibrations				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To provide the students an understanding of different kinds of satellites, their design, dynamics and their components					

UNIT I INTRODUCTION TO SATELLITE SYSTEMS 9

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT II SATELLITE DYNAMICS 9

Fundamental of satellite dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements.

UNIT III SATELLITE STRUCTURES & THERMAL CONTROL 9

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT IV SPACECRAFT CONTROL 9

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT V POWER SYSTEM AND BUS ELECTRONICS 9

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Kaetc), their characteristics and applications-Coding Systems – Onboard computer- Ground checkout Systems.

TEXTBOOKS:

1. Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.

REFERENCES:

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Rilay, FF, McGraw Hill, 1982.
3. Principles of Astronautics Vertregt. M., Elsevier Publishing Company, 1985
4 Space Communications Systems, Richard.F, FilipowskyEugen I Muehllorf Prentice Hall,

1995
5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAAEducation Series, 1991.

WEBLINKS:
https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall-2003/

COURSE OUTCOMES	
CO 1	**Discuss** the basics of satellites and its system's functions. **(Understand)**
CO 2	**Describe** the fundamentals of orbital mechanics and the coordinate systems. **(Understand)**
CO 3	**Analyze** the satellite structures and thermal protection systems. **(Analyze)**
CO 4	**Express** the attitude controls and its stabilization schemes. **(Understand)**
CO 5	**Summarize** various types of power systems and bus electronics. **(Understand)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H												H	
	CO2	H									H			H	
	CO3	H												H	
	CO4	H									H			H	
	CO5	H												H	
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

U18PCAS7L1	SATELLITE DESIGN LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Basic Electricals and Electronics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To help the student to understand the process of satellite design.

LIST OF EXPERIMENTS

1 Introduction – Payload Specifications and Requirements
2 Study of Various Types of Sensors and Accessories in Nano Satellites
3 Cost Estimation and Feasibility Studies
4 Design and Fabrication of a Structural Framework for a Nano Satellites
5 Demonstration of Onboard GPS for recovery
6 Design of Communication System for Data Transfer
7 Design of Thermal Protection System
8 Design of Electro Magnetic Shield
9 Exercise on Selection of Appropriate Power Source and Distribution System
10 Assembling and Packing of Nano Satellite

REFERENCES:

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Riley, FF, McGraw Hill, 1982.

WEBLINKS:

https://www.aticourses.com/small_satellite_design.htm
https://www.newspaceindia.com/course-on-piconanomicro-satellites-design/

COURSE OUTCOMES	
CO 1	Perform investigation on accessories in nano satellites
CO 2	Design of satellite subsystems
CO 3	Demonstrate the systems in nano satellite

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H				H				H	H		H	H	
	CO2	H				H				H	H		H	H	
	CO3	H				H				H	H		H	H	
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

U18EEAS7P1	PROJECT PHASE I	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Gas Dynamics, Aircraft Structural Mechanics, Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

1. To acquaint the student with theoretical and experimental studies related to aeronautical science.
2. To enable the student to get involved in key area of research in the branch of study.
3. To perform the literature studies and survey that will help in formulating the problem statement.
4. To enable the student to understand the concept of the acquired statement to get the idea about the work.
5. To work according to the acquired idea and to develop report in the form as specified in the guidelines

DESCRIPTION

The objective of the project phase I is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Each student shall finally produce a comprehensive report covering background information, literature survey and problem statement. This final report shall be in typewritten form as specified in the guidelines.

COURSE OUTCOMES	
CO 1	**Observe** the current market scenario to develop new or modify the existing product. **(Imitation)**
CO 2	**Build** a preliminary design of the prototype. **(Manipulation)**
CO 3	**Point out** the methodology for implementation of design. **(Manipulation)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
2	CO1	H								H	H		H	H	
	CO2	H								H	H		H	H	
	CO3	H								H	H		H	H	
3	Category	Professional Core (PC)													
4	Approval	48th Academic Council Meeting													

SEMESTER VIII

	PROJECT WORK	L	T	P	C
	Total Contact Hours – 18 hours per week	**0**	**0**	**18**	**9**
U18PRAS8P1	Prerequisite – Low Speed Aerodynamics, Aircraft Structural Mechanics, Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

1. To introduce to the student about the scientific method of research
2. To accustom the student to the processes involved during a project work
3. To enable the student to understand the concepts of scrutiny to get the idea about the work that takes place during a project
4. To familiarize the student on the preparation of technical reports/paper of his/her project work
5. To enable the student to be able to make a proper presentation of his/her assigned work/project

DESCRIPTION

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Eighteen periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be in typewritten form as specified in the guidelines.

COURSE OUTCOMES	
CO 1	**Tell** the value of achieving perfection in projects implementation & completion. **(Imitation)**
CO 2	**Build** the skills, competencies and point of view of designed concepts. **(Naturalization)**
CO 3	**Replicate** professional skills in Presentation, Technical report writing, critical thinking and decision making. **(Manipulation)**

Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	**COs/ POs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
2	CO1	H	H	H						H	H			L	L
	CO2	H	H	H		H				H	H			L	L
	CO3	H	H	H		H				H	H			L	L
3	**Category**	**Professional Core (PC)**													
4	**Approval**	**48th Academic Council Meeting**													

PROFESSIONAL ELECTIVE I (PE I)

U18PEAS011	**SPACE MISSION DESIGN AND ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Introduction to Aerospace Engineering				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the students learn basics of Space Mission design process					

UNIT I SPACE MISSION DESIGN PROCESS 9

Classification of space missions – Low earth, Medium altitude, Geo-stationary, deep space, space mission life cycle, Mission objectives, identification of mission needs, requirements and constraints, mission characterization, mission evaluation, orbit and constellation design - Space Environment – peculiarities, survivability, selection of spacecraft material - Selection of launch systeM

UNIT II SPACECRAFT SYSTEM ENGINEERING 9

Spacecraft design and sizing, spacecraft payload design, spacecraft subsystems, functional requirement - Propulsion, attitude determination and control, power systems, thermal control, navigation and guidance, telemetry, tracking and command systems, ground system design

UNIT III GENERAL N-BODY PROBLEM 9

Relative Motion in the N-body Problem, Two body problem, orbit determination techniques, Kepler's equation, Lamberts problem - Restricted Three Body Problem – Lagrange points - Jacobi Integral, orbital perturbation

UNIT IV SATELLITE INJECTION AND REENTRY FLIGHT DYNAMICS 9

Launching of a satellite - General aspects of satellite Injections, launch vehicle ascent trajectories, injection parameters and orbital elements, launch vehicle performance, orbit deviations due to injection errors - Reentry flight dynamics – fundamentals of entry flight mechanics, fundamentals of entry heating, entry vehicle design, landing and recovery techniques

UNIT V INTERPLANETARY TRAJECTORIES 9

Patched Conic Approximation - Patched Conic Procedure - Sphere of Influence - Locating the Planets - Design of the Transfer Ellipse - Design of the Departure Trajectory - Design of the Arrival Trajectory - Gravity-Assist maneuver - Establishing Planetary Orbit – Motion of the Earth-Moon System - Time of Flight and Injection Velocity - Lunar Patched Conic

TEXTBOOKS:

1. Cornelisse, J.W, Schoyer H F R, and Wakker K F, "Rocket Propulsion and Space Dynamic", Pitman Publishing Co., 1979

REFERENCES:

1. Peter Fortescue, John Stark, Graham Swinerd, "Spacecraft systems engineering" Wiley 2004
2. Vincent N Pisacane, "Fundamentals of space system design" Oxford University Press, 2005
3. W J Larson and J R Wertz, "Space Mission Analysis and Design", Kluwer Academic Publishers, 1999.
4. Michael Griffin, "Space Vehicle Design", AIAA education series, 2004

5. Ashish Tewari, “Atmospheric and Space Flight Dynamics”, Birkhauser, Boston, 2007

WEBLINKS:
https://www.aticourses.com/space_mission_analysys.html

COURSE OUTCOMES	
CO 1	Describe the basic process of space mission design (understand)
CO 2	Classify the various spacecraft systems and their design (understand)
CO 3	Summarize orbit determination techniques and n body problems (understand)
CO 4	Identify the concepts of launching and reentry of vehicles (understand)
CO 5	Develop the trajectory and orbits for space vehicles (apply)

U18PEAS012	SYSTEMS ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce the concepts related to system engineering and its significance with respect to aerospace systems.					

UNIT I INTRODUCTION 9

Overview, Systems definition and concepts, Conceptual system design, Systems thinking and Systems Engineering.

UNIT II DESIGN AND DEVELOPMENT 9

Detail Design Requirements, The Evolution of Detail Design, Design Data, Information, and Integration, Various phases in product life cycle, Systems verification & Integration

UNIT III DESIGN FOR OPERATIONAL FEASIBILITY 9

Design for Reliability, Maintainability, Usability, Sustainability and Affordability - Definition and Explanation, Measures, System Life Cycle cost, Analysis Methods, Practical considerations.

UNIT IV SYSTEMS ENGINEERING MANAGEMENT 9

Systems Engineering Planning and Organization, Systems Engineering Management Plan (SEMP), Program Leadership and Direction, Risk Management, Evaluation and Feedback.

UNIT V CASE STUDIES 9

Systems Integration -Aircraft Systems, Missile Systems, Satellite Systems-Launch Vehicle Systems and Radar, Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems

TEXTBOOKS:

1. Systems Engineering and Analysis by Benjamin S. Blanchard / WolterJ.Fabrycky, Prentice Hall, International Version 2010

REFERENCES:

1. Alexander Kossiakoff, William N. Sweet, Systems Engineering : Theory & Practice, John Wiley &Sons, 2002
2. James N. Martin, Systems Engineering Guidebook: A Process for Developing Systems and Products, CRC Press, 1997
3. Gandoff, M.,(1990). Systems Analysis and Design
4. Andrew P Sage and James E Armstrong, Systems Engineering, Wiley Inter science publications, (2004)

WEBLINKS:

https://www.coursera.org/learn/systems-engineering

COURSE OUTCOMES	
CO 1	Explain the conceptual system design (Understand)
CO 2	Describe the stage s of product development (Understand)
CO 3	Observe the parameters influencing the design (Remember)
CO 4	Enumerate the factors related to systems engineering management(Remember)
CO 5	Appraisevarious systems and their processes, faults, rectifications etc through case studies.(ANALYSE)

	LAUNCH VEHICLE AERODYNAMICS	L	T	P	C
U18PEAS013	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Applied Dynamics and Vibrations, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the students with the fundamentals of the aerodynamics of launch vehicles					

UNIT I BASICS OF HIGH SPEED AERODYNAMICS 9

Compressible flows-Isentropic relations-mathematical relations of flow properties across shock and expansion waves-fundamentals of Hypersonic Aerodynamics

UNIT II BOUNDARY LAYER THEORY 9

Basics of boundary layer theory-compressible boundary layer-shock shear layer interaction - Aerodynamic heating-heat transfer effects

UNIT III LAUNCH VEHICLE CONFIGURATIONS AND DRAG ESTIMATION 9

Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nosecone design and drag estimation.

UNIT IV AERODYNAMICS OF SLENDER AND BLUNTBODIES 9

Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles-determination of aero elastic effects.

UNIT V AERODYNAMIC ASPECTS OF LAUNCHING PHASE 9

Booster separation-crosswind effects-specific consideration sin missile launching-missile integration and separation-methods of evaluation and determination-Stability and Control Characteristics of Launch Vehicle Configuration-Wind tunnel tests –Comparison with CFD Analysis.

TEXTBOOKS:

1. Anderson, J.D., “Fundamentals of Aerodynamics”, McGraw-Hill BookCo. NewYork, 2010. (Units 1 & 2)
2. Chin SS, Missile Configuration Design, McGrawHill, New York, 1961. (Unit 3)
3. Anderson, J.D., “Hypersonic and High Temperature Gas Dynamics”, AIAA Education Series.(Units 4 & 5)

REFERENCES:

1. Nielson, Jack N, Stever, Gutford, “Missile Aerodynamics”, McGraw Hill, New York, 1960.
2. Anderson Jr.,D.,–“Modern compressible flows”, McGraw-Hill BookCo.,NewYork1999.
3. Charles D.Brown, “Spacecraft Mission Design”, AIAA Education Series, Published by AIAA, 1998
4. Elements of Space Technology for Aerospace Engineers”, Meyer Rudolph X, Academic Press,1999

WEBLINKS:

https://www.edx.org/course/flight-vehicle-aerodynamics-mitx-16-110x-0

COURSE OUTCOMES	
CO 1	Summarize the fundamentals of high speed aerodynamics (understand)
CO 2	Discuss the importance of the boundary layer study in high speed flows (understand)
CO 3	Identify the various configurations of launch vehicles (understand)
CO 4	Examine the aerodynamic concepts of slender and blunt bodies (apply)
CO 5	Observe the importance of aerodynamics during the launching phase (understand)

	BOUNDARY LAYER THEORY	L	T	P	C
U18PEAS014	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Fluid Mechanics, Co-requisite – Gas Dynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To enable the student to understand about the various aspects of viscous flow, laminar and turbulent boundary layer, prediction of skin friction drag					

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW 9

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Nondimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS 9

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER EQUATIONS 9

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER EQUATIONS 9

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modeling

UNIT V COMPRESSIBLE BOUNDARY LAYERS EQUATIONS 9

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

TEXTBOOKS:

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York, 2005.

REFERENCES:

1. Schlichting, H., Boundary Layer Theory, McGraw-Hill, New York, 2000.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc16_me04

COURSE OUTCOMES	
CO 1	**Recall** the fundamental equations of viscous flow and basics of boundary layer theory. **(Understand)**
CO 2	**Discuss** the solutions of simplified viscous flow equations. **(Understand)**
CO 3	**Discuss** theequations and methods used for solving the flow field of laminar boundary layer over a flat plate. **(Understand)**
CO 4	**Describe** the basics of Turbulent boundary layer. **(Understand)**
CO 5	**Describe** the basics of Compressible boundary layer. **(Understand)**

PROFESSIONAL ELECTIVE II (PE II)

U18PEAS021	**THEORY OF ELASTICITY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions					

UNIT I BASIC EQUATIONS OF ELASTICITY 9

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS 9

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES 9

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs

UNIT IV TORSION 9

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS 9

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TEXTBOOKS:

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.

REFERENCES:

1. Enrico Volterra& J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991.
2. Wng, C.T., "Applied Elasticity", McGraw–Hill Co., New York, 1993.
3. Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw–Hill New York,1978.

COURSE OUTCOMES	
CO 1	The student will know about the basic equations of elasticity
CO 2	The student will be able to solve plane stress and plane strain problems using modules
CO 3	The student will know the procedure of coordinates system.
CO 4	The student will understand the procedure of conduct torsion problems
CO 5	The student will get an idea of theory of plates and shells

U18PEAS022	MANNED SPACE MISSIONS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Introduction to Aerospace Engineering				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the students with the basic requirements and mission planning for manned space missions.

UNIT I INTRODUCTION 9

The physics of space - Current missions: space station, Moon mission, and Mars missions - Engineering challenges on Manned vs. unmanned missions - Scientific and technological gains from space programs - Salient features of Apollo and Space station missions – space shuttle mission

UNIT II EFFECT OF SPACE ENVIRONMENT 9

Atmosphere: Structure and Composition - - Atmosphere: Air Pressure, Temperature, and Density - Atmosphere: Meteoroid, Orbital Debris & Radiation Protection - Human Factors of Crewed Spaceflight,Safety of Crewed Spaceflight - Magnetosphere - Radiation Environment: Galactic Cosmic Radiation (GCR), Solar Particle Events (SPE) - Radiation and the Human Body – Impact of microgravity and g forces on humans – space adaptation syndrome.

UNIT III LIFE SUPPORT SYSTEMS 9

Life Support Systems and Space Survival Overview - - Environment Controlled Life Support Systems - Human / Machine Interaction - - Human Factors in Control Design – Crew Accommodations

UNIT IV MISSION PLANNING 9

Ground Communication and Support - Space Resources and Mission Planning - Space Mission Design: Rockets and Launch Vehicles - Orbital Selection and Astrodynamics, Entry, Descent, Landing, and Ascent, Designing and Sizing Space elements, Transfer, Entry, Landing, and Ascent Vehicles, Designing, Sizing, and Integrating a Surface Base, Planetary Surface Vehicles

UNIT V SPACECRAFT SUBSYSTEMS 9

Spacecraft Subsystems: Space Operations - Space Architecture, Attitude Determination and Control - Designing Power Systems - Extravehicular Activity Systems - Space Robotics – Mission Operations for Crewed Spaceflight - Command, Control, and Communications Architecture

TEXTBOOKS:

1. Larson, W. J. and Pranke, L. K., Human Spaceflight: Mission Analysis and Design, McGrawHill Higher Education, Washington, DC , 1999

REFERENCES:

1. Connors, M.M., Harrison, A.A., and Akins, F.R. 2005. Living Aloft: Human Requirements for Extended Spaceflight, University Press of the Pacific,Honolulu, Hawaii: ISBN: 1-4102-1983-6
2. Eckart, P. 1996. Spaceflight Life Support and Biospherics.
3. McNamara, Bernard. 2000. Into the Final Frontier: The Human Exploration of Space. (Brooks Cole Publishing.)

WEBLINKS:
https://www.edx.org/course/human-spaceflight-introduction-kthx-sd2905-1x-0

COURSE OUTCOMES	
CO 1	Identifythe basics of manned space missions (remember)
CO 2	Describe the effect of space environment on spacecraft and living things(Understand)
CO 3	Generalize the various life support systems necessary for manned space missions (understand)
CO 4	Sketch various plans for space missions (Apply)
CO 5	Explain the different subsystems of a spacecraft (Understand)

U18PEAS023	ELECTRIC PROPULSION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Rocket Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce basic physics of electric propulsion systems.					

UNIT I INTRODUCTION TO THE BASIC PHYSICS OF ELECTRIC PROPULSION SYSTEMS 8

Historical outline - Definition of Electric Propulsion - High impulse Space Missions - Exhaust velocity and specific impulse - Power supply penalty – Electric charges and Electrostatic fields - Currents and Magnetic interactions - Time dependent fields and Electromagnetic wave propagation - Application to ionized gas flows

UNIT II PHYSICS OF IONIZED GASES 12

Atomic structure of gases - Ionization processes - Particle collisions in an ionized gas - Electrical conductivity of an ionized gas - Kinetic Theory

UNIT III ELECTRO-THERMAL PROPULSION 9

One dimensional model - Enthalpy of high temperature gases - Frozen flow efficiency - Resistojets - Electrical discharges - Arcjets - Operation and Analysis - Materials - Advantages and Disadvantages

UNIT IV ELECTROMAGNETIC PROPULSION 9

The Lorentz force - Magnetogasdynamics channel flow - Ideal steady flow acceleration - Thermal and viscous losses - Geometry considerations - Self induced fields - Sources of the conducting gas - The magnetoplasmadynamic arc - Magneto- plasmadynamic (MPD) thrusters - Pulsed plasma acceleration - Pulsed plasma thrusters (PPT) - Quasi steady acceleration - Pulsed inductive acceleration - Traveling wave acceleration

UNIT V ELECTROSTATIC PROPULSION 7

One dimensional space-charge flows - Basic relationships - The acceleration- deceleration concept - Ion engines - Design and Performance - Hall effect – Hall thrusters - Field emission electric propulsion (FEEP) - Colloid thrusters

TEXTBOOKS:

1. Robert G. Jahn, “Physics of Electric Propulsion”, McGraw-Hill Series, New York, 1968.

REFERENCES:

1. George W. Sutton, “Engineering Magneto hydrodynamics”, Dover Publications Inc., New York, 2005 2. George P. Sutton & Oscar Biblarz, “Rocket Propulsion Elements, John Wiley & Sons Inc., New York, 8th Edition, 2010.

WEBLINKS:

https://engineering.purdue.edu/ProEd/courses/electric-propulsion

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-522-space-propulsion-spring-2015/

COURSE OUTCOMES	
CO 1	LIST different types of techniques used in electric PROPULSION(Remember)
CO 2	Discuss the properties of ionized gases (Understand)
CO 3	Classify electro thermal propulsive engines (understand)
CO 4	Identify the engines working based on electromagnetic propulsion(Understand)
CO 5	Explain the field electric propulsive systems

U18PEAS024	SPACECRAFT POWER SYSTEMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electricals and Electronics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: The students will understand the advanced concepts of Spacecraft power systems, its elements, energy storage technology, power convertors and power distribution.

UNIT I SPACECRAFT ENVIRONMENT & DESIGN CONSIDERATION 9

Orbit definition /Mission Requirements of LEO, GEO, GTO & HEO, Lunar orbits, IPO with respect to Power Generation – Power System Elements - Solar aspect angle Variations

UNIT II POWER GENERATION 9

Study of Solar spectrum - Solar cells - Solar Panel design - Solar Panel Realization – Solar Panel testing - Effects of Solar cells and panels (IR, UV, Particles)

UNIT III ENERGY STORAGE TECHNOLOGY 9

Types of batteries – Primary & Secondary batteries - Nickel Cadmium - Nickel-Hydrogen – Nickel metal hydride - Lithium-ion –Lithium Polymer - Silver Zinc– Electrical circuit model – Performance characteristics of batteries - Application of batteries in launch vehicles and satellites – Fuel Cell – Polymer Electrolyte membrane Fuel Cell – Regenerative Fuel Cell

UNIT IV POWER CONVERTERS 9

DC – DC converters – Basic Convertors - Buck, Boost, Buck- boost converter –Derived converters: Fly back converter – Transformer coupled forward converter – Push-Pull converter - CUKs convertor– Resonant converter – Voltage and current regulators

UNIT V POWER CONTROL, CONDITIONING AND DISTRIBUTION 9

Solar Array Regulators – Battery changing schemes – Protection Schemes - Distribution – Harness - Thermal Design - EMI/EMC/ESD/Grounding schemes for various types of circuits and systems

TEXTBOOKS:

1. Patel, Mukund R, ‘Spacecraft Power Systems’ CRC Press Boca Raton, 2005

REFERENCES:

1. Hyder, A k et.al, ‘Space Power Technologies’ Imperial College Press London,2000
2. Fortescue, Peter et.al, ‘Spacecraft Systems Engineering’ John Wiley England,2003.
3. P R K Chetty, ‘Spacecraft Power Systems’, 1978.

WEBLINKS:

https://www.aticourses.com/spacecraft_power_systems.htm
https://online-learning.tudelft.nl/courses/spacecraft-technology/

COURSE OUTCOMES	
CO 1	Recall the concepts of orbits in space(Remember)
CO 2	Discuss the techniques involved in solar panels (understand)
CO 3	Classify the types of power storage systems in space applications(Understand)
CO 4	List the efficient power convertors for space applications (Remember)
CO 5	Describe the schemes involved in power conversion and distribution(understand)

PROFESSIONAL ELECTIVE (PE) III

U18PEAS031	**HYPERSONIC AERODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Gas Dynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To study the environment around hypersonic vehicles and bodies created by strong shock waves.					

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight paths – hypersonic similarity parameters-shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS 9

Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self similar boundary layers-solution methods for non self similar boundary layers aerodynamic heating.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions.

UNIT V INTRODUCTION TO HIGH TEMPERATURE EFFECTS 9

Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

TEXTBOOKS:

1. EthirajanRathakrishnan., "High Enthalpy Gas Dynamics", John Wiley and Sons, 2015

REFERENCES:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA Series, New York, 2006.
2. John. D. Anderson. Jr., "Modern compressible flow with historical perspective", McGraw Hill Publishing Company, New York, 1996.
3. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc.,Washington. D.C., 1994.

WEBLINKS:

https://nptel.ac.in/courses/101103003/

COURSE OUTCOMES	
CO 1	**Recall** the concepts of compressible flows and differentiate between supersonic and hypersonic flows. **(Remember)**
CO 2	**Discuss** simple solution methods of hypersonic inviscid flows. **(Understand)**
CO 3	**Discuss** the basics of viscous hypersonic flows. **(Understand)**
CO 4	**Describe** the shock shear layer interaction in hypersonic flows. **(Understand)**
CO 5	**Discuss** basics of high temperature flows. **(Understand)**

	VIBRATIONS AND ELEMENTS OF AERO ELASTICITY	L	T	P	C
U18PEAS032	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To know about the role of Vibrations, vibration analysis and ideas about Aero elasticity in engineering and industry and design and analysis of components subject to vibrations.

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Vibration Terminologies, Simple harmonic motion, Newton's law, D' Alembert's principle, Energy methods, Free vibrations, Damped vibrations, Forced Vibrations with and without damping, Support excitation, Transmissibility, Vibration measuring instruments.

UNIT II MULTI DEGREE OF FREEDOM SYSTEMS 10

Two degrees of freedom systems, static and dynamic couplings, Vibration absorbers, Principal co-ordinates, principal modes and orthogonal condition, Eigen value problems, Lagrangean equations and applications.

UNIT III CONTINUOUS SYSTEMS 8

Vibration of elastic bodies, vibration of strings, Longitudinal –lateral and Torsional vibrations.

UNIT IV APPROXIMATE METHODS 9

Approximate methods-Rayleigh's method, Dunkerleys method, Holzer method, Matrix iteration method

UNIT V ELEMENTS OF AEROELASCTICITY 8

Vibrations due to coupling of bending and torsion, collars triangle, aero elastic instabilities and their prevention, Wing divergence,reversal of aileron control, Flutter and its prevention.

TEXTBOOKS:

1. V. P. Singh, "Mechanics of Vibration", (Units 1 to 4)
2. Y.C. Fung, "An Introduction to the Theory of Aeroelasticity", John Wiley & Sons Inc., New York, 2008. (Unit 5)

REFERENCES:

1. Leonard Meirovitch, "Fundamentals of Vibrations", McGraw Hill International Series, 2001
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aeroelasticity – Addison Wesley Publication, New York, 1983.
3. R.H. Scanlan and R.Rosenbaum, "Introduction to the study of Aircraft Vibration and Flutter", Macmillan Co., New York, 1981.
4. R.D.Blevins, "Flow Induced Vibrations", Krieger Pub Co., 2001
5. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.
6. Timoshenko S., Vibration Problems in Engineering – John Wiley and Sons, New York, 1993.

WEBLINKS:

https://swayam.gov.in/course/4531-introduction-to-mechanical-vibration

CO 1	**Compute** the natural frequency of SDOF systems under free and forced vibrations. **(Apply)**
CO 2	**Determine** the frequency of vibrating body using instruments. **(Apply)**
CO 3	**Calculate** principle mode of vibration for MDOF systems. **(Apply)**
CO 4	**Calculate** the natural frequency of continuous systems. **(Apply)**
CO 5	**Calculate** natural frequency of MDOF systems using approximate methods. **(Apply)**
CO 6	**Discuss** the problems in aeroelastic instability and its prevention. **(Understand)**

U18PEAS033	SPACE VEHICLE DESIGN	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Elements of Aerospace Structures				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce to the student about the design of a space vehicle					

UNIT I FUNDAMENTAL ASPECTS OF SPACE SYSTEMS ENGINEERING 9

Space Systems Engineering – Definition, Requirements of Systems Engineering, Design Team, Tradeoffs, Top level requirements, Functional requirements, Functional Block diagram, Tradeoff analysis, Communication Systems and Power systems, Technology Tradeoffs

UNIT II SPACE MISSIONS 9

Space Missions - Low Earth Orbit, Flight Tests, Earth Observation, Space observation, Medium Altitude Earth Orbit, Geosynchronous Earth Orbit, Communications Satellites, Weather satellites, Lunar and Deep space missions – Inner and outer planetary missions, Observation of small bodies – comets and asteroids, Orbit Design Considerations, Advanced Mission concepts-Large Space structures, Space stations, space colonies, Use of lunar and asteroid materials, Nuclear waste disposal

UNIT III ENVIRONMENTAL CONSTRAINTS 9

Natural and Manmade environments, Earth environment – corrosion due to humidity, Clean room, problems in transporting, Launch environment, Shuttle Vibration, Atmospheric environment – wind shear constraint, density shear, Effect of Polar mesospheric clouds during re – entry, Space and Upper Atmosphere environment – Effect of vacuum on materials, Space plasma and spacecraft charging, Magnetic field, Weightlessness and microgravity, Radiation – Van Allen Radiation belt, Micrometeoroids, Orbital debris, Thermal environment

UNIT IV LAUNCH VEHICLE SELECTION AND ATMOSPHERIC ENTRY 9

Solid vs Liquid propellant, Hybrid propulsion, Space shuttle payload accommodations, expendable launch vehicles, Atmospheric entry – Requirements, fundamentals of entry flight mechanics, ballistic entry, gliding entry, skip entry, Cross-Range entry, Entry heating, free molecular heating, Thermal protection, Entry vehicle design

UNIT V STRUCTURAL DESIGN CONSIDERATIONS 9

Vehicle center of mass, Vehicle moment of inertia, structural loads, load alleviation, modal analysis, fracture mechanics, stress levels and safety factors, large structures, structural materials, films and fabrics

TEXTBOOKS:

1. Michael D.Griffin and James R. French, " Space Vehicle design" AIAA Education Series, Second Edition, 2004

REFERENCES:

1. NickolayZosimovych, " Commercial Launch Vehicle Design" , LAP LAMBERT Academic Publishing , 2016

WEBLINKS:

https://www.uclaextension.edu/engineering/engineering-short-courses/course/space-launch-vehicle-design-and-system-engineering

COURSE OUTCOMES

CO 1	Describe the fundamentals of space systems
CO 2	Demonstrate various space mission program
CO 3	Examine the challenges in space environment
CO 4	Classify the method of selection to launch vehicle and methods for re entry
CO 5	Determine the structural parameters in space system design

U18PEAS034	SOLAR THERMAL ENERGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To learn the basics of solar thermal energy					

UNIT I INTRODUCTION 9

Introductory aspects of non-renewable and renewable energy sources – fundamentals of thermal radiation – resource assessment – solar radiation concepts – solar-earth geometry – models to predict global and daily and hourly irradiation.

UNIT II SOLAR COLLECTION THEORY AND TECHNOLOGIES 8

Heat transfer in solar collectors – basic modeling aspects – steady and dynamic analysis – performance parameters.

UNIT III SOLAR CONCENTRATION SYSTEMS AND RECEIVERS 10

Overview and introduction to concentration optics – concentration ratio and thermodynamic maximum – linear concentration: trough and linear Fresnel – point concentration: dish and tower (central receiver system).

UNIT IV SOLAR POWER GENERATION SYSTEMS 9

Overview and types of systems – components and sub systems – aspects of design and performance prediction.

UNIT V THERMAL STORAGE AND SOLAR COOLING 9

Need for thermal storage – methods – simple models for thermal storage - solar liquid absorption and solar solid sorption technologies

TEXTBOOKS:

1. Boyle, G., Renewable Energy: Power for a Sustainable Future, 3rd ed., Oxford Univ. Press (2012).

REFERENCES:

1. Duffie, J. A. and Beckman, W. A., Solar Engineering of Thermal Processes, John Wiley (1991).
2. Sukhatme, S. P. and Nayak, J. K., Solar Energy: Principles of Thermal Collection and Storage, 3rd ed., McGraw-Hill (2009).

WEBLINKS:

https://solarenergytraining.org/
https://www.edx.org/course/solar-energy

COURSE OUTCOMES	
CO 1	Describe the different techniques to extract energy form the sun (Understand)
CO 2	Discuss the modeling and analysis of solar collectors (Understand)
CO 3	Explain the principle , working methodology for solar concentrators and receivers (understand)
CO 4	Classify solar power generation systems based on efficiencies (understand)
CO 5	Identify the models for thermal storage and cooling systems (Understand)

PROFESSIONAL ELECTIVE (PE) IV

U18PEAS041	**INTRODUCTION TO COMBUSTION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Fundamentals of Aero – Thermodynamics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To acquaint the student with the basics of combustion in aircraft and rocket engines.					

UNIT I INTRODUCTION TO COMBUSTION 9

Thermochemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – Stoichiometric ratio, equivalence ratio – measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES 9

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE ENGINES 9

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, fuels used for gas turbine combustion chambers – combustion stability – ramjet combustion – differences between the design of ramjet combustion chambers and gas turbine combustion chambers- flame holders types – numerical problems.

UNIT IV COMBUSTION IN SCRAMJET ENGINES 9

Introduction to supersonic combustion – need for supersonic combustion for hypersonic air-breathing propulsion- supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors.

UNIT V COMBUSTION IN ROCKET ENGINES 9

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion hybrid rockets

TEXTBOOKS:

1. Stephen R turns, ”An Introduction to Combustion”, Tata Mc.Graw Hill Publishing Co., Ltd., New Delhi, Reprint 2013. (Units 1 & 2)
2. Lefebvre AG and Dilip R ballal, “Gas Turbine Combustion”, CRC press, Third Edition, 2010. (Unit 3)
3. Corin Segal, “The Scramjet engine”, Cambridge University Press, 2009 (Unit 4)
4. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 7th Edition, 2001 (Unit 5)

REFERENCES:

1. Warnatz J, Maas U and Dibble RW, ”Combustion”, Springer, Fourth Edition,2006.
2. Beer, J.M., and Chiger, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
3. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987

WEBLINKS:
https://swayam.gov.in/course/4339-fundamentals-of-combustion-i

COURSE OUTCOMES	
CO 1	**Explain** thermo chemical reaction associated with combustion process and the various parameters affecting burning velocity. **(Understand)**
CO 2	**Select** apt fuel for optimum combustion in piston engines. **(Analyze)**
CO 3	**Compare** the ramjet and gas turbine combustion chamber design. **(Understand)**
CO 4	**Analyze** the challenges associated with supersonic combustion.**(Analyze)**
CO 5	**Discuss** combustion process in solid, liquid propellant rockets and hybrid rockets. **(Understand)**

U18PEAS042	THEORY OF PLATES AND SHELLS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVES

To acquaint about the classic plate theory, method of analysis various shapes and concept of shell.

UNIT I CLASSICAL PLATE THEORY 9

Classical Plate Theory – Assumptions – Differential Equations – Boundary Conditions – Axi-Symmetric Loading.

UNIT II PLATES OF VARIOUS SHAPES **9**

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions – Annular Plates – Plates of other shapes.

UNIT III EIGEN VALUE ANALYSIS **9**

Stability and Free Vibration Analysis of Rectangular Plates.

UNIT IV APPROXIMATE METHODS **9**

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT V SHELLS **9**

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

Text Books:

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. Varadhan. T. K. &Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

References:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw Hill Book Co.1986.
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Llyod Hamilton, Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. AnselUgural, Stresses in Plates & Shells, McGraw Hill, 1981
6. Reddy.J.N., "Theory & Analysis of Elastic Plates", CRC, I Edition, 1999

COURSE OUTCOMES	
CO 1	**Explain** the classical plate theory subjected to Axi-symmetric loading. **(Understand)**
CO 2	**Use** Navier's method and Levy's method to obtain solution for rectangular plates under different boundary conditions. **(Apply)**
CO 3	**Illustrate** the stability and free vibration analysis of rectangular plates. **(Understand)**
CO 4	**Apply** various approximate methods on rectangular plates for stability analysis. **(Apply)**
CO 5	**Describe** the concepts of shell type structures and bending theories for circular cylindrical shells. **(Understand)**

U18PEAS043	**SPACECRAFT ATTITUDE DYNAMICS AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Space Flight Mechanics				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To familiarize the student with the basics of spacecraft attitude dynamics and control					

UNIT I ATTITUDE SENSORS 8

Relative Attitude sensors – Gyroscopes, Motion reference Units, Absolute Attitude sensors – Horizon sensor, Orbital Gyrocompass, Earth sensors, sun sensors (Digital and analog), star sensor- Magnetometer

UNIT II CONTROL ACTUATORS 9

Fundamental principles of operation of Thrusters- Momentum Wheel-Control Moment Gyros Reaction wheel- Magnetic Torques- Reaction Jets- Ion Propulsion- Electric propulsion- solar sails

UNIT III ATTITUDE DYNAMICS, ATTITUDE AND ORBITAL DISTURBANCES 9

Rigid Body Dynamics - Flexible body Dynamics - Slosh Dynamics- disturbing forces due to Drag, Solar radiation Pressure and forces - Disturbances due to Celestial bodies

UNIT IV ATTITUDE STABILIZATION SCHEMES & ORBIT MANEUVERS 10

Spin, Dual spin - Gravity gradient - Zero momentum system - Momentum Biased system - Reaction control system - Single and Multiple Impulse orbit Adjustment - Hohmann Transfer Station Keeping and fuel Budgeting

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE 9

Operating principles and design of guidance laws - homing guidance laws- short range - Medium range and BVR missiles - Launch Vehicle- Introduction - Mission requirements- Implicit guidance schemes - Explicit guidance - Q guidance schemes

TEXTBOOKS:

1. Marcel J. Sidi, “Spacecraft Dynamics and control, A Practical Engineering Approach”, Cambridge University Press.2000

REFERENCES:

1. James R Wertz, Spacecraft Attitude Determination and control, Reidel Publications.2001.
2. Vladimir AChobotov,”Spacecraft Attitude Dynamics and Control (Orbit)”, Krieger Publishing Company Publishers, 1991.
3. Blake Lock, J.H ‘Automatic control of Aircraft and missiles ‘, John Wiley Sons, New York, 1990.
4. Meyer Rudolph X, Elements of Space Technology for Aerospace Engineers”, Academic Press, 1999
5. Kaplan M, “Modern Spacecraft Dynamics and control”, Wiley Press, 1979.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc19_ae04

https://www.coursera.org/specializations/spacecraft-dynamics-control

COURSE OUTCOMES	
CO 1	Describe the sensors used in spacecraft to determine the attitude (understand)
CO 2	Classify the different types of control actuators (understand)
CO 3	Discuss the reasons behind orbital / attitude disturbances (Understand)
CO 4	Establish relevant equations for stabilization systems (Apply)
CO 5	Compare missile guidance and control methods (Understand)

U18PEAS044	HIGH TEMPERATURE GAS DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Compressible Flow				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To enable the student to understand about the basics of high temperature gas flows

UNIT I INTRODUCTION 8

Importance of high temperature flows –Atmospheric Entry-Nature of High temperature flows-Chemical Effects in Air- High temperature effects in rocket engines

UNIT II STATISTICAL THERMODYNAMICS 8

Introduction to statistical thermodynamics – Microscopic Description of Gases-Boltzmann Distribution- Partition Function-Thermodynamic properties of High Temperature Air.

UNIT III KINETIC THEORY AND HYPERSONIC FLOWS 9

Chemical equilibrium calculation of equilibrium composition of high temperature air – equilibrium properties of high temperature air – collision frequency and mean free path – velocity and speed distribution functions.

UNIT IV INVISCID HIGH TEMPERATURE FLOWS 10

Equilibrium and non – equilibrium flows – governing equations for inviscid high temperature equilibrium flows – equilibrium normal and oblique shock wave flows – frozen and equilibrium flows – equilibrium conical and blunt body flows – governing equations for non-equilibrium inviscid flows.

UNIT V TRANSPORT PROPERTIES IN HIGH TEMPERATURE GAS 10

Transport coefficients – mechanisms of diffusion – total thermal conductivity – transport characteristics for high temperature air – radiative transparent gases – radiative transfer equation for transport, absorbing and emitting and absorbing gases

TEXTBOOKS:

1. "EthirajanRathakrishnan", "High Enthalpy Gas Dynamics", John Wiley and Sons, 2017

REFERENCES:

1. John D. Anderson, Jr., Hypersonic and High Temperature Gas Dynamics, McGraw-Hill Series, New York, 1996.
2. John D. Anderson, Jr., Modern Compressible Flow with Historical perspective McGraw Hill Series, New York, 1996.
3. William H. Heiser and David T. Pratt, Hypersonic Air breathing propulsion, AIAA Education Series.
4. John T. Bertin, Hypersonic Aerothermodynamics publishers - AIAA Inc., Washington, D.C., 1994.
5. .K.Bose, High Temperature Gas Dynamics

WEBLINKS:

https://engineering.purdue.edu/ProEd/courses/molecular-gas-dynamics
https://www.iitk.ac.in/new/ae690a

COURSE OUTCOMES	
CO 1	Acquiring comprehensive knowledge on high temperature gas dynamics

CO 2	Understand the concept of statistical thermodynamics for high temperature flows
CO 3	Acquire knowledge on kinetic properties of high temperature flows
CO 4	Understand oblique and curved shock waves and shock wave structure in high temperature flows
CO 5	Know the transport mechanisms in high temperature gas.

PROFESSIONAL ELECTIVE (PE) V

U18PEAS051	**SPACE FLIGHT MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Introduction to Aerospace Engineering				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce to the student about the basic concepts in space mechanics and about the laws that govern motion in space					

UNIT I BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM 10

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem- Lagrange-Jacobi identity – the circular restricted three body problem – libration points – the general N-body problem two body problems – relations between position and time.

UNIT II SATELLITE INJECTION AND SATELLITE PERTURBATIONS 9

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT III INTERPLANETARY TRAJECTORIES 9

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem

UNIT IV BALLISTIC MISSILE TRAJECTORIES 9

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.

UNIT V MATERIALS FOR SPACECRAFT 8

Space environment – peculiarities of space environment – effect of space environment on materials of spacecraft structure – materials required for the construction of space craft – TPS for re-entry space vehicles.

TEXTBOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman &Co., Ltd, London, 1982

REFERENCES:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 7th Edition, 2001.
2. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc., 1982.

WEBLINKS:

https://online.stanford.edu/courses/aa279a-space-mechanics

COURSE CONTENT	
COURSE OUTCOMES	
CO 1	Describe n-body problem with terminologies(understand)
CO 2	Discuss the methods for satellite injection , parking and transfer orbits(understand)
CO 3	Examine the interplanetary trajectories for manned and unmanned missions to other planets (Apply)
CO 4	Explain the need and importance of trajectory for ballistic missiles(analyze)
CO 5	Interpret the effect of space environment on materials

	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
U18PEAS052	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Mechanics and Machines, Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE:

To make the student understand on experimental method of finding the response of the structure to different types of load.

UNIT I MEASUREMENTS AND EXTENSOMETERS 9

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 9

Principle of operation and requirements, Types and their uses, Materials for strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT III PHOTOELASTICITY 9

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission and Reflection polariscopes, Interpretation of fringe pattern, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE METHODS 9

Introduction to Moiré techniques, Brittle coating methods and Holography

UNIT V NON – DESTRUCTIVE TESTING 9

Fundamentals of NDT, Radiography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing, Acoustic Emission Technique

TEXTBOOKS:

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, 2009.

REFERENCES:

1. Hetenyi, M., “Hand book of Experimental Stress Analysis”, John Wiley and Sons Inc., New York, 1972.
2. Max Mark Frocht,” Photo Elasticity”, John Wiley and Sons Inc., New York, 1968
3. A.J.Durelli, “Applied Stress Analysis”, Prentice Hall of India Pvt Ltd., New Delhi, 1970
4. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., “Experimental Stress Analysis”, Tata McGraw Hill, New Delhi, 1984.
5. James F. Doyle ,”Modern Experimental Stress Analysis “,John Wiley & Sons, 2004.
6. Ramesh, K., ” Experimental Stress Analysis”, Indian Institute of Technology Madras, India,E-book,2009.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_me39/preview

COURSE OUTCOMES	
CO 1	**Describe** the working principle of different extensometers and their uses. **(Understand)**
CO 2	**Compute** the strain in loaded structures based on measurement of change in resistance using strain gauges. (**Apply**)
CO 3	**Discuss** the techniques used for determination of stress in photo elastic materials. **(Understand)**
CO 4	**Explain** the concepts of more technique and brittle coating techniques. **(Understand)**
CO 5	**Summarize** the fundamentals of NDT and **Describe** the different type of NDT methods. **(Understand)**

U18PEAS053	AUTOMATIC CONTROL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electrical and Electronics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To equip the student with the various methods necessary to carry out the design and analysis of aerospace control systems.

UNIT I SYSTEM AND REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – Block diagram reduction techniques

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input- I and II order system response – Error coefficients – Generalised error series – Steady state error- P, PI, PID modes of feedback control – Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response – Bode plot- polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT IV CONCEPT OF STABILITY 9

Characteristics equation – Root Locus construction - Routh Hurwitz stability criterion

UNIT V SAMPLED DATA SYSTEMS 9

Sampled data control systems- functional elements – sampling process- z-transforms- properties inverse z transforms – ZOH and First Order Hold process- pulse transfer functions – step response – Introduction to digital control system, Digital Controllers and Digital PID controller

TEXTBOOKS:

1. Nagarath.I.J. andGopal M, " Control System Engineering', New Age International Publishers, New Delhi, 2015. (Units 1 to 4)
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995 (Unit 5)

REFERENCES:

1. OGATO, Modern Control Engineering, Fifth Edition, Prentice-Hall of India Pvt.Ltd., New Delhi, 2010.
2. Kuo, B.C. Automatic Control Systems, Prentice-Hall of India Pvt.Ltd., New Delhi, 2009.
3. Azzo, J.J.D. and C.H. Houpis, Feedback Control System Analysis And Synthesis, McGraw-Hill International 3rd Edition, 1998.
4. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi, 1998.

WEBLINKS:

https://onlinecourses.nptel.ac.in/noc18_ee41/course

COURSE OUTCOMES	
CO 1	**Analyze** mathematical model for mechanical and Electrical systems. **(Analyze)**
CO 2	**Analyze** time response of the system with various test inputs and steady state errors. (**Analyze**)
CO 3	**Analyze** the frequency response of the system and correlate frequency - time domain specifications. (**Analyze**)
CO 4	**Predict** the stability of the system using Root Locus and Routh Hurwitz stability criterion. (**Evaluate**)
CO 5	**Discuss** the basic components of Digital Control System. **(Understand)**

U18PEAS054	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Aerodynamics, Numerical Methods				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To equip the student with the knowledge of various numerical techniques to carry out flow analysis.					

UNIT I GOVERNING EQUATIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations. Time-Averaged Equations for Turbulent flow – Reynolds Stress Equations.

UNIT II FDM AND FVM FOR DIFFUSION PROBLEMS 10

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady One, Two and Three dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FVM FOR CONVECTION – DIFFUSION PROBLEMS 9

Steady one-dimensional convection diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes. - SIMPLE, SIMPLER algorithms.

UNIT IV TURBULENCE MODELING 9

Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models. Large eddy simulation- Direct numerical simulation.

UNIT V APPLICATIONS 8

Large Scale problems in CFD – Iterative Solvers – Preconditioning Techniques – Vector and Parallel Computing – Post Processing for Visualization – CFD analysis using commercial packages and programming

TEXTBOOKS:

1. H.K. Versteeg and W. Malalasekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", Longman Scientific & Technical, 2007. (Units 1 to 3)
2. JiyuanTu, Guan, HengYeoh, Chaoqun Liu, "Computational Fluid Dynamics A Practical Approach" Springer Verlag, 2012. (Units 4 & 5)

REFERENCES:

1. J. D. Anderson, "Computational Fluid Dynamics", McGraw Hill International, 2012.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
3. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.

WEBLINKS:

http://www.cfdonline.com

https://onlinecourses.nptel.ac.in/noc16_ch02

COURSE OUTCOMES	
CO 1	**Describe** governing equations of fluid dynamics. (**Understand**)
CO 2	**Apply** appropriate Finite Difference method and Finite volume method for solving diffusion problems. (**Apply**)
CO 3	**Analyze** various explicit and implicit schemes in Finite Volume Method for solving one dimensional convection diffusion problems. (**Analyze**)
CO 4	**Identify** suitable turbulence model for fluid flow problems. (**Understand**)
CO 5	**Analyze** Computational Fluid Dynamics problems by using packages and programming software. (**Analyze**)

PROFESSIONAL ELECTIVE (PE) VI

U18PEAS061	**CRYOGENIC ROCKET PROPULSION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Advanced Aerospace Propulsion				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To introduce to the student the basics of cryogenic systems and associated processes and cryogenic rocket technology.					

UNIT I INTRODUCTION TO CRYOGENIC SYSTEMS 9

Cryogenic systems and basic components, Properties of Cryogenic fluids, Liquefaction systems, ideal, Cascade, LindeHampson and Claude cycles and their derivatives; Refrigerators: Stirling, Gifford-McMahon cycles and their derivatives. Cryogenic Insulations: Foam, Fibre, powder and Multilayer.

UNIT II CRYO FUEL SYSTEMS 9

Cryogenic and semi – cryogenic propellants - Hydrogen - properties, and pretreatment - Liquefaction of hydrogen - Linde, Claude and helium - hydrogen condensing cycles, Ortho-para conversion. Storage and handling of liquefied hydrogen

UNIT III CRYO EQUIPMENT AND ACCESSORIES 9

Mechanical and Thermal Properties of engineering materials at low temperatures; Compressors: types, construction and characteristics; Expansion machines: characteristics of reciprocating and turbine expanders, design of J-T expander; Heat exchangers: types, design approaches and selection criteria, Design of cryogenic storage vessels, transfer devices, insulation system, valves; Characteristics of cryogenic pumps, Instrumentation in cryogenic systems

UNIT IV CRYOGENIC ENGINES 9

Fluid circuits of various cryogenic engines and semi-cryogenic engines; Design of regeneratively cooled combustion chamber, film cooling, dump cooling, transpiration cooling and radiation cooling. Design of expansion nozzle- characteristics, Design of injector–hydraulic characteristics; Engine thrust and mixture ratio control, Igniters, Propellant tanks.

UNIT V CHALLENGES IN CRYOGENIC ROCKET TECHNOLOGY 9

Problems in storage and handling of cryogenic propellants: safety aspects, Thermal protectionsystems for stage tanks, Thermal stratification- destratification, Geysering effect – geyseringelemination, Zero “g” problems – restart mechanism.

TEXTBOOKS:

1. “A text book of Cryogenics”, “Valery V. Kostionk”, Discovery Publishing House, 2010. (Units 1 to 3)
2. “Operation of a Cryogenic Rocket Engine”, “Kitsche, Wolfgang”, Springer Publications, 2011. (Units 4 & 5)

REFERENCES:

1. “Rocket Propulsion Elements”, “Sutton G. P., Bibliarz”

WEBLINKS:

https://nptel.ac.in/courses/112101004/

COURSE OUTCOMES	
CO 1	**Discuss** the basic components of cryogenic systems. **(Understand)**
CO 2	**Explain** the types of cryogenic propellant used and their storage and handling. **(Understand)**
CO 3	**Discuss** cryo equipment and accessories of cryogenic engine system. **(Understand)**
CO 4	**Discuss** various subsystem involved in the operation of cryogenic engine and their design aspects. **(Understand)**
CO 5	**Discuss** the challenges in cryogenic rocket technology. **(Understand)**

U18PEAS062	HIGH TEMPERATURE MATERIALS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fundamentals of Structural Mechanics				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To acquaint the student with the fundamentals of creep, hot corrosion, fracture mechanisms under high temperature and alloys for high temperature applications.

UNIT I INTRODUCTION TO HIGH TEMPERATURE MATERIALS 6

Components exposed to high temperatures, significance of high temperature materials, recent trends in high temperature material research

UNIT II CREEP AND DESIGN FOR CREEP RESISTANCE 12

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate. Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE 9

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, and ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT IV OXIDATION AND HOT CORROSION 9

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPER ALLOYS AND OTHER MATERIALS 9

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

TEXTBOOKS:

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985. (Units 1, 2, 3 & 5)
2. David J. Young, "High Temperature Oxidation and Corrosion of Metals", Second Edition, Elsevier Science Ltd., 2016 (Unit 4)

REFERENCES:

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.
4. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
5. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

WEBLINKS:
https://nptel.ac.in/courses/113105019/

COURSE OUTCOMES	
CO 1	**Discuss** the effect of creep on the functional life of components. **(Understand)**
CO 2	**Explain** the creep resistance of ductile and brittle materials. **(Understand)**
CO 3	**Describe** the effect of different alloys and oxidesmaterials behaviour from low temperature to high temperature **. (Understand)**
CO 4	**Discuss** the fracture mechanism maps for different alloys and oxides**. (Understand)**
CO 5	**Describe** the process of oxidation and different oxidations prevention techniques. **(Understand)**
CO 6	**Discuss** the various types of super alloys and its strengthening mechanisms. **(Understand)**

U18PEAS063	STRUCTURAL DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				

OBJECTIVE: To study the effect of periodic and a periodic forces on mechanical systems with matrix approach and also to get the natural characteristics of large sized problems using approximate methods.

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

Constraints and Generalized coordinates-Virtual work and generalized forces- Force-Deflection influence functions-stiffness and flexibility methods.

UNIT II PRINCIPLES OF DYNAMICS 9

Free and forced vibrations of systems with finite degrees of freedom-Damped oscillations-D" Alembert's principle-Hamilton's principle-Lagrangean equations of motion and applications.

UNIT III NATURAL MODES OF VIBRATION 9

Equations of motion for Multi degree of freedom Systems - Solution of Eigen value problems – Normal coordinates and orthogonality Conditions. Modal Analysis.

UNIT IV ENERGY METHODS 9

Rayleigh's principle-Rayleigh-Ritz method-Coupled natural modes-Effect of rotary inertia and shear on lateral vibrations of beams-Natural vibrations of plates.

UNIT V APPROXIMATE METHODS 9

Approximate methods of evaluating the Eigen values and the dynamic response of continuous systems. Application of Matrix methods for dynamic analysis.

TEXTBOOKS:

1. F. S. Tse, I. E. Morse and H. T. Hinkle, "Mechanical Vibration", Prentice Hall of India Pvt. Ltd, NeW Delhi, 1988.
2. W. C. Hurty and M. F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd, New Delhi, 1987.

REFERENCES:

1. R. K. Vierck, "Vibration Analysis" 2nd Edition, Thomas Y. Crowell & Co Harper &Row Publishers, New York, U.S.A. 1989.
2. S. P. Timoshnko ad D. H. Young, "Vinration Problems in Engineering", John Willey & Sons Inc., 1984.
3. von Karman and A. Biot, "Mathematical Methods in Engineering", McGraw-Hill Book Co.,New York, 1985.
4. Ramamurthi. V., "Mechanical Vibration Practice and Noise Control" Narosa Publishing House Pvt. Ltd, 2008

COURSE OUTCOMES	
CO 1	**Review** stiffness and flexibility method of structural analysis (**Understand)**
CO 2	**Describe** the significance of dynamic loadingand **solve** forced vibrations of finite degree of freedom systems (**Apply**).
CO 3	**Explain** modal analysis of multiple degree of freedom systems (**Analyze**).
CO 4	**Apply** energy methods to solve beam and plate vibrations problems under dynamics loads (**Apply**).
CO 5	**Evaluate** dynamic response of continuous systems using approximate methods (**Analyze**)

	HIGH TEMPERATURE PROBLEMS IN AEROSPACE STRUCTURES	L	T	P	C
U18PEAS064	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Aeronautical Engineering				
OBJECTIVE: To study the effect of Temperature effects in aerospace applications.					

UNIT I TEMPERATURE EQUATIONS & AERODYNAMIC HEATING 9

For condition, radiation and convection – Fourier's equation – Boundary and initial conditions – One-dimensional problem formulations – Methods and Solutions. Heat balance equation for idealised structures – Adiabatic temperature – Variations – Evaluation of transient temperature.

UNIT II THERMAL STRESS ANALYSIS 9

Thermal stresses and strains – Equations of equilibrium – Boundary conditions – Thermoelasticity – Two dimensional problems and solutions – Airy stress function and applications.

UNIT III THERMAL STRESS IN BEAMS, TRUSSES AND THIN CYLINDERS 9

Thermal stresses in axially loaded members, beams with varying cross sections. Effect of temperature in thin cylinders.

UNIT IV THERMAL STRESSES IN PLATES 9

Membrane thermal stresses – Circular plates – Rectangular plates – Bending thermal stresses – Thick plates with temperature varying along thickness – Thermal vibration of plates.

UNIT V SPECIAL TOPICS & MATERIALS 9

Thermal bucking, Fatigue and shock applications – High temperature effects on material properties.

TEXTBOOKS:

1. A.B. Bruno and H.W. Jerome, "Theory of Thermal Stresses", John Wiley & Sons Inc., New York, 1980.
2. N.J. Hoff, "High Temperature effects in Aircraft Structures", John Wiley & Sons Inc., London, 1986.

REFERENCES:

1. D.J. Johns, "Thermal Stress Analysis", Pergamon Press, Oxford, 1985.

COURSE OUTCOMES	
CO 1	Describe basic parameters of Aerodynamic heating and temperature effects..
CO 2	Demonstrate the important principles of Stress analysis in thermal problems.
CO 3	Solve for thermal stress in bars, cylinders
CO 4	Detect the variousstresses in rectangular, circular plates
CO 5	Determine the high temperature effect on modern materials

CURRICULUM AND SYLLABUS(R2018)

CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

B. Arch – BACHELOR OF ARCHITECTURE

(FULL TIME)

I-X SEMESTERS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR101	HISTORY OF ARCHITECTURE I	PC	3	3	0	0	3
2	U18PCAR102	THEORY OF ARCHITECTURE I	PC	3	3	0	0	3
3	U18ESAR103	MECHANICS OF STRUCTURES I	BS & AE	4	2	2	0	3
4	U18HSEN102	ENGLISH	PAEC	3	2	0	2	3
5	U18BSMA103	MATHEMATICS	BS	4	2	2	0	3
STUDIO								
6	U18PCAR1L1	ARCHITECTURAL BASIC DESIGN	PC	12	0	0	12	6
7	U18PCAR1L2	ARCHITECTURAL GRAPHICS AND ART STUDIO	PC	5	1	0	4	3
			TOTAL	**34**	**13**	**4**	**18**	**24**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18ESAR203	MECHANICS OF STRUCTURES II	BS & AE	4	2	2	0	3
2	U18ECAR202	PERSONALITY DEVELOPMENT	PAEC	4	2	0	2	3
THEORY CUM STUDIO								
3	U18PCAR201	ARCHITECTURAL GRAPHICS – II	PC	5	1	0	4	3
4	U18ESAR204	MATERIALS AND CONSTRUCTION I	BS & AE	5	1	0	4	3
STUDIO								
5	U18PCAR2L1	ARCHITECTURAL DESIGN I	PC	12	0	0	12	6
6	U18PCAR2L2	MODEL MAKING AND ARCHITECTURAL DELINEATION	PC	4	0	0	4	3
			TOTAL	**34**	**6**	**2**	**26**	**21**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR301	HISTORY OF ARCHITECTURE II	PC	3	3	0	0	3
2	U18ESAR302	DESIGN OF STRUCTURES I	BS & AE	3	2	2	0	3
3	U18ESAR303	BUILDING SERVICES I	BS & AE	3	2	0	2	3
4	U18ESAR305	CLIMATOLOGY	BS & AE	3	2	0	2	3
THEORY CUM STUDIO								
5	U18ESAR304	MATERIALS AND CONSTRUCTION II	BS & AE	4	1	0	4	3
STUDIO								
6	U18PCAR3L1	ARCHITECTURAL DESIGN II	PC	14	0	0	14	8
7	U18PCAR3L2	COMPUTER STUDIO I	PAEC	**4**	**1**	**0**	**4**	**3**
			TOTAL	**34**	**11**	**2**	**26**	**26**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR401	HISTORY OF ARCHITECTURE III	PC	3	3	0	0	3
2	U18ESAR402	DESIGN OF STRUCTURES II	BS & AE	4	2	2	0	3
3	U18ESAR403	BUILDING SERVICES II	BS & AE	3	2	0	2	3
4	U18PCAR406	SITE SURVEYING AND PLANNING	PC	3	2	0	2	3
5	U18ESAR405	ENVIRONMENTAL SCIENCE FOR BUILT ENVIRONMENT	BS & AE	3	3	0	0	3
THEORY CUM STUDIO								
6	U18ESAR404	MATERIALS AND CONSTRUCTION III	BS & AE	5	1	0	4	3
STUDIO								
7	U18PCAR4L1	ARCHITECTURAL DESIGN III	PC	14	0	0	14	8
			TOTAL	**35**	**13**	**2**	**22**	**26**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR501	HISTORY OF ARCHITECTURE IV	PC	3	3	0	0	3
2	U18ESAR502	DESIGN OF STRUCTURES III	BS & AE	4	2	2	0	3
3	U18ESAR503	BUILDING SERVICES III	BS & AE	4	2	0	2	3
4		PROFESSIONAL ELECTIVE I	PE	3	3	0	0	3
THEORY CUM STUDIO								
5	U18ESAR504	MATERIALS AND CONSTRUCTION IV	BS & AE	5	1	0	4	3
STUDIO								
6	U18PCAR5L1	ARCHITECTURAL DESIGN IV	PC	14	0	0	14	8
7	U18PCAR5L2	COMPUTER STUDIO II	PAEC	4	1	0	4	3
			TOTAL	**37**	**12**	**2**	**24**	**26**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	
THEORY								
1	U18PCAR601	HISTORY OF ARCHITECTURE V	PC	3	3	0	0	
2	U18PCAR602	HUMAN SETTLEMENT AND PLANNING	PC	3	3	0	0	
3	U18ESAR603	ACOUSTICS	BS & AE	4	3	0	0	
4		PROFESSIONAL ELECTIVE II	PE	3	3	0	0	
THEORY CUM STUDIO								
5	U18ESAR604	MATERIALS AND CONSTRUCTION V	BS & AE	5	1	0	4	
STUDIO								
6	U18PCAR6L1	ARCHITECTURAL DESIGN V	PC	16	0	0	16	
			TOTAL	**34**	**13**	**0**	**20**	

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR701	COST ESTIMATION AND BUDGETTING	PC	3	3	0	0	3
2	U18PCAR702	PROJECT MANAGEMENT	PAEC	3	3	0	0	3
3	U18PCAR703	URBAN DESIGN	PC	3	3	0	0	3
4		PROFESSIONAL ELECTIVE III	PE	3	3	0	0	3
THEORY CUM STUDIO								
5	U18ESAR704	MATERIALS AND CONSTRUCTION V	BS & AE	5	1	0	4	3
STUDIO								
6	U18PCAR7L1	ARCHITECTURAL DESIGN VI	PC	16	0	0	16	8
			TOTAL	**33**	**13**	**0**	**20**	**23**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1	U18PCAR801	PROFESSIONAL ETHICS AND PRACTICE	PAEC	3	3	0	0	3
2	U18PCAR802	URBAN HOUSING	PC	3	3	0	0	3
3		PROFESSIONAL ELECTIVE IV	PE	3	3	0	0	3
4		PROFESSIONAL ELECTIVE V	PE	3	3	0	0	3
STUDIO								
5	U18PCAR8L1	ARCHITECTURAL DESIGN VII	PC	16	0	0	16	8
6	U18PCAR8L2	DISSERTATION	PAEC	**8**	0	0	**8**	**6**
			TOTAL	**36**	**12**	**0**	**24**	**26**

SEMESTER IX

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
STUDIO								
1	U18PCAR9PT	PRACTICAL TRAINING	PAEC	FULL DURATION OF SEMESTER	**–**	**–**	**–**	**12**
			TOTAL	**FULL DURATION OF SEMESTER**	**–**	**–**	**–**	**12**

SEMESTER X

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P/S	C
THEORY								
1		PROFESSIONAL ELECTIVE VI	PE	3	3	0	0	3
STUDIO								
2	U18PCARXTH	THESIS	PC	**32**	**0**	**0**	**32**	**18**
			TOTAL	**35**	**3**	**0**	**32**	**21**

TOTAL NO OF CREDITS	**228**

PROFESSIONAL ELECTIVE (PE)								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P/S**	**C**
PROFESSIONAL ELECTIVE I								
1	U18PEAR001	VERNACULAR ARCHITECTURE	PE	3	3	0	0	3
2	U18PEAR002	THEORY OF DESIGN	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE II								
3	U18PEAR003	SUSTAINABLE ARCHITECTURE	PE	3	3	0	0	3
4	U18PEAR004	GLASS ARCHITECTURE AND DESIGN	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE III								
5	U18PEAR005	INTERIOR DESIGN	PE	3	3	0	0	3
6	U18PEAR006	EARTHQUAKE RESISTANT BUILDINGS	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE IV								
7	U18PEAR007	LANDSCAPE AND ECOLOGY	PE	3	3	0	0	3
8	U18PEAR008	CONTEMPORARY PROCESS IN ARCHITECTURE	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE V								
9	U18PEAR009	ADVANCED STRUCTURES	PE	3	3	0	0	3
10	U18PEAR010	STEEL ARCHITECTURE AND DESIGN	PE	3	3	0	0	3
PROFESSIONAL ELECTIVE VI								
11	U18PEAR011	ARCHITECTURAL CONSERVATION	PE	3	3	0	0	3
12	U18PEAR012	ARCHITECTURAL JOURNALISM AND PHOTOGRAPHY	PE	3	3	0	0	3

PROFESSIONAL CORE COURSES (PC)

Sl.No	Code No	Course Title	Contact Periods	L	T	P	C
1	U18PCAR101	HISTORY OF ARCHITECTURE I	3	3	0	0	3
2	U18PCAR102	THEORY OF ARCHITECTURE I	3	3	0	0	3
3	U18PCAR1L1	ARCHITECTURAL BASIC DESIGN	12	0	0	12	6
4	U18PCAR1L2	ARCHITECTURAL GRAPHICS AND ART STUDIO	5	1	0	4	3
5	U18PCAR201	ARCHITECTURAL GRAPHICS – II	5	1	0	4	3
6	U18PCAR2L1	ARCHITECTURAL DESIGN I	12	0	0	12	6
7	U18PCAR2L2	MODEL MAKING AND ARCHITECTURAL DELINEATION	4	0	0	4	3
8	U18PCAR301	HISTORY OF ARCHITECTURE II	3	3	0	0	3
9	U18PCAR3L1	ARCHITECTURAL DESIGN II	14	0	0	14	8
10	U18PCAR401	HISTORY OF ARCHITECTURE III	3	3	0	0	3
11	U18PCAR406	SITE SURVEYING AND PLANNING	3	2	0	2	3
12	U18PCAR4L1	ARCHITECTURAL DESIGN III	14	0	0	14	8
13	U18PCAR501	HISTORY OF ARCHITECTURE IV	3	3	0	0	3
14	U18PCAR5L1	ARCHITECTURAL DESIGN IV	14	0	0	14	8
15	U18PCAR601	HISTORY OF ARCHITECTURE V	3	3	0	0	3
16	U18PCAR602	HUMAN SETTLEMENT AND PLANNING	3	3	0	0	3
17	U18PCAR6L1	ARCHITECTURAL DESIGN V	16	0	0	16	8
18	U18PCAR701	COST ESTIMATION AND BUDGETTING	3	3	0	0	3
19	U18PCAR703	URBAN DESIGN	3	3	0	0	3
20	U18PCAR7L1	ARCHITECTURAL DESIGN VI	16	0	0	16	8
21	U18PCAR802	URBAN HOUSING	3	3	0	0	3
22	U18PCAR8L1	ARCHITECTURAL DESIGN VII	16	0	0	16	8
23	U18PCARXTH	THESIS	**32**	**0**	**0**	**32**	**18**
Total Credits							**120**

BUILDING SCIENCESAND APPLIED ENGINEERING (BS & AE)

SL.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	U18ESAR103	MECHANICS OF STRUCTURES I	4	2	2	0	3
2	U18BSMA103	MATHEMATICS	4	2	2	0	3
3	U18ESAR203	MECHANICS OF STRUCTURES II	4	2	2	0	3
4	U18ESAR204	MATERIALS AND CONSTRUCTION I	5	1	0	4	3
5	U18ESAR302	DESIGN OF STRUCTURES I	3	2	2	0	3
6	U18ESAR303	BUILDING SERVICES I	3	2	0	2	3
7	U18ESAR305	CLIMATOLOGY	3	2	0	2	3
8	U18ESAR304	MATERIALS AND CONSTRUCTION II	4	1	0	4	3
9	U18ESAR402	DESIGN OF STRUCTURES II	4	2	2	0	3
10	U18ESAR403	BUILDING SERVICES II	3	2	0	2	3
11	U18ESAR405	ENVIRONMENTAL SCIENCE FOR BUILT ENVIRONMENT	3	3	0	0	3
12	U18ESAR404	MATERIALS AND CONSTRUCTION III	5	1	0	4	3
13	U18ESAR502	DESIGN OF STRUCTURES III	4	2	2	0	3
14	U18ESAR503	BUILDING SERVICES III	4	2	0	2	3
15	U18ESAR504	MATERIALS AND CONSTRUCTION IV	5	1	0	4	3
16	U18ESAR603	ACOUSTICS	4	3	0	0	3
17	U18ESAR604	MATERIALS AND CONSTRUCTION V	5	1	0	4	3
18	U18ESAR704	MATERIALS AND CONSTRUCTION V	5	1	0	4	3
Total Credits							**54**

PROFESSIONAL ABILITY ENHANCEMENT COURSES (PAEC)

SL.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	U18HSEN102	ENGLISH	3	2	0	2	3
2	U18ECAR202	PERSONALITY DEVELOPMENT	4	2	0	2	3
3	U18PCAR3L2	COMPUTER STUDIO I	4	1	0	4	3
4	U18PCAR5L2	COMPUTER STUDIO II	4	1	0	4	3
5	U18PCAR702	PROJECT MANAGEMENT	3	3	0	0	3
6	U18PCAR801	PROFESSIONAL ETHICS AND PRACTICE	3	3	0	0	3
7	U18PCAR8L2	DISSERTATION	**8**	0	0	**8**	**6**
8	U18PCAR9PT	PRACTICAL TRAINING	FULL DURATION OF SEMESTER	–	–	–	**12**
Total Credits							**36**

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester										No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII	IX	X		
1	Professional Core (PC)	15	12	11	14	11	14	14	11	-	18	120	52.63%
2	Building Sciences and Applied Engineering (BS & AE)	6	6	12	12	9	6	3	-	-	-	54	23.68%
3	Professional Ability Enhancement Courses (PAEC)	3	3	3	-	3	-	3	9	12	-	36	15.78%
4	Professional Elective	-	-	-	-	3	3	3	6	-	3	18	8%
	Total Credit	24	21	26	26	26	23	23	26	12	21	228	-
	Total Contact Hour	34	34	34	35	37	34	33	36	FULL SEMESTER	35		-

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 1LI	ARCHITECTURAL BASIC DESIGN	0	0	14	6

OBJECTIVES:

- To understand the elements and principles of Basic Design as the building blocks of Creative design through exercises that will develop originality, expression, skill and creative thinking.
- To involve students in a number of exercises to understand the grammar of Design and Visual composition.
- To enable the understanding of 3D Composition by involving students in a number of exercises which will help generation of a form from a two dimensional / abstract idea.
- To understand architecture as a craft, of making and of putting together.
- To sensitize students to materials both planar and plastics and Processes involved in working with them.
- To draw inspiration and clues from nature.
- To introduce Drawing as an analytical tool.
- To introduce students to History of Design and craft.

UNIT I INTRODUCTION TO BASIC DESIGN 1 9

Introduction to architectural design –

- Line
- Direction
- Shape
- Size
- Texture
- Value colour.

UNIT II WORKSHOP

Using of carpentry, masonry model making, space frame models, such as match sticks, straw, steel wire etc.

TOTAL: 75 PERIODS

Text Book:

1. Francis DK Ching – "Form space and order"

2. VS. Prammar – "Design fundamentals in architecture"

References:

1. Edward D. Mills – "Planning the Architects handbook, London 1985"

2. Paul Laseau , Graphic thinking for Architects and Designers, John Wiley & Sons, New York , 2

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Identify the basic design elements and principles and applying the same in designing
CO2	Develop the skills of art appreciation and sense of aesthetics by studying, correlating the basic design principles and works of master architects.
CO3	Developing the skills of expressing the ideas visually through sketching, renderings using different media.
CO4	An ability to engage and combine the elements of design in spontaneous as well as intentional ways in order to create desired qualities and effects.
CO5	An understanding of the qualities of different elements as well as their composite fusions.
C06	An ability to engage and combine the elements of design in spontaneous as well as intentional ways in order to create desired qualities and effects

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				L		M		L			L	
	CO2	H											M
	CO3		M		L			H		H			
	CO4					L	M		L		M		
	CO5		M									L	
	C06							H					L
3	Category	Professional Core (PC)											
4	Approval	26th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 101	THEORY OF ARCHITECTURE – I	3	0	0	3

OBJECTIVES:

- To understand that architecture is a dynamic interface between man and his environment: through its constituent aspects and elements.
- To understand the various principles of architectural design, with which the above objective is attained.
- To understand that architecture is communicative medium involving aspects of expression and experience.
- To understand the various possibilities of approaching architectural design, through examples from historical and contemporary examples.

UNIT I INTRODUCTION 9

APPLICATION OF COLOUR IN ARCHITECTURE

Effect of Colour in architecture – Colour symbolism.

UNIT II

ORGANISATION OF FORMS AND SPACES

a) Spatial Relationship

i) Space within space

ii) Interlocking Spaces

iii) Adjacent spaces

iv) Space linked by a common space.

b) Spatial Organization – influencing factors and their types

i) Centralized

ii) Linear

iii) Radial

iv) Clustered

v) Grid

c) Articulation of forms and spaces types

i) Edges and Corners

ii) Surface.

UNIT III

Factors influencing the character and style of buildings. Study of examples from Buddhist, Hindu and Islamic Architecture in India – Greek, Roman, Gothic, Renaissance, Modem and Post Modern Movement.

UNIT IV

PRINCIPLES OF COMPOSITION

Unity, Harmony and specific qualities of design to include Dominance, Punctuating Effect, Dramatic Effect, Fluidity, Climax, Accentuation and Contrast with building examples.

UNIT V

CIRCULATION

Function of building circulation components of building circulation – The building approach, the building entrance, Configuration of the Path, path space relationship, from of circulation space with examples.

Simple circulation diagram for buildings.

TOTAL: 45 PERIODS

Text Book:

1. Sir-Bannister Fletcher – "A History of Architecture", Butterworths, London, 1987.

2. Francis D.K. Ching, Architecture – "Forms, Space and Order", Van Nostrand Publications, New York, 1979.

3. Paul Alan Johnson - The Theory of Architecture - Concepts and Themes - Van Vostrand Reinhold Co – 1994

4. V.S. Pramar, Design Fundamental in Architecture - Somaiya Publications Pvt. Ltd. New Delhi,1973

References:

1. Ernest Burden – "Elements of Architectural Design" – A Visual resource, Van Nostrand Reinhold, 1994.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To know the difference between architecture and engineering.
CO2	Understand the primary elements and forms in architecture, their role and impact on architecture and the development of new forms by applying the same techniques.
CO3	Understand about the elements and fundamentals Techniques of space making of space making.
CO4	An exposure to the principles of architecture and applications of the same in buildings.
CO5	A thorough understanding on the definition of architecture; elements of architectures of form.
C06	An understanding the meaning of character and style of buildings with examples.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	H					H	H		H
	CO2		H		M	H			M		L	H	
	CO3	H				L				M			H
	CO4		L							M		M	
	CO5	H	M	M	M				M		H		H
	C06			M			L						
3	Category	Professional Core (PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 102	HISTORY OF ARCHITECTURE – I	3	0	0	3

OBJECTIVES:

- To inform about the development of architecture in the Ancient Western World and the cultural and contextual determinants that produced that
- To understand architecture as evolving within specific cultural contexts including aspects of politics, society, religion and climate.
- To gain knowledge of the development of architectural form with reference to Technology, Style and Character in the prehistoric world, Ancient Egypt, West Asia, Greece , Rome, Medieval times and Renaissance period.

UNIT I

PREHIST AND EGYPT 9

Old stone age – the agricultural revolution – the new stone age – development of shelter – nature of art and architecture – out line of architectural character pyramid of Cheops – temple of Ammoon etc.,

UNIT II

WEST ASIA 8

Sumerian, Babylonian and Persian cultures – architectural characters – Ziggurats – Palace of Sargoan – Palace at Persepolis

UNIT III

GREECE 10

Evolution of city states – arts culture development – classical periods – architectural characters – orders in architecture examples Parthenon of Athens, Erecthion, Theatre etc.,

UNIT IV

ROME 6

Republican States – factors influencing architecture – out line of architectural character – examples.

UNIT V

EARLY CHRISTIAN AND BYZANTINE 12

British and spread of Christianity – church forms – out line of architectural character and various examples.

TOTAL: 45 PERIODS

Text Book:

1. Sir Banister Fletcher "A History of Architecture"

References:

1. Spiro Kostof – "A History of Architecture"
2. Pier Liugi Nervi – "History of World Architecture New York 1972"

COURSE OUTCOMES (COs)	
The student will be able	
CO 1	***Understand*** the origin of architecture in prehistoric age in western world.
CO 2	***Understand*** the origin of architecture in prehistoric age in western world.
CO 3	Know the importance of the history, relate to design thinking, cultural aspiration, social needs, and the evolution of the built environment
CO 4	Interpret the characteristics of designing of temples and tombs by Egyptian, Babylonian, and Mesopotamian, Greek, Rome and Byzantine builders.
CO 5	Compare spatial and stylistic qualities associated with church architecture
C06	An Understanding of architecture as an outcome of various social, political and economic upheavals, and as a response to the cultural and context.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M			M	H	H		H
	CO2	L		M	M						L	H	L
	CO3		L			L			M				H
	CO4									M		M	H
	CO5		M	M	M				M		H	W	
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 103	MECHANICS OF STRUCTURES I	3	0	0	3

OBJECTIVES:

- To enable a student to understand the effect of action of forces on a body and the concept of equilibrium of the body through exercises.
- To determine the internal forces induced in truss members due to external loads by working out
- problems.
- To calculate the sectional properties (centroid, moment of inertia, section modulus and radius of gyration) for various sections by working out problems.
- To study the stress – strain behaviours of steel and concrete due to axial loads and to determine the stresses and strains developed in solids due to external action through select problems.
- To derive the relationship between elastic constants and solving problems.

UNIT I **9**

FORCES AND STRUCTURAL SYSTEMS

Types of force systems – Resultant of parallel forces – principle of moments –principle of equilibrium – simple problems.

UNIT II **8**

ANALYSIS OF PLANE TRUSSES

Introduction to determinate and indeterminate Plane trusses – Analysis of simple supported and cantilevered trusses by method of joints and method of sections.

UNIT III **10**

PROPERTIES OF SECTION

Centroid – Moment of Inertia – Section modulus – Radius of gyration – Theorem of perpendicular axis – Theorem of parallel axis.

UNIT IV **6**

ELASTIC PROPERTIES OF SOLIDS

Stress strain diagram for mild steel, High tensile steel and concrete – concept of axial and volumetric stresses and strains.

UNIT V **12**

ELASTIC CONSTANTS

Elastic constants – Relation between elastic constants – Application to problem

Text Book:

1. P.C. Punmia, "Strength of Materials and Theory of Structures", Vol 1, Laxmi Publications, Delhi 1994.

2. S. Ramamurtham, "Strength of Materials", Dhanpatrai & Sons, Delhi 1990.

References:

1. W.a. Nash, "Strength of Materials" – Schaums Series – McGraw Hill Book Company, 1989.

2. R.K. Bansal – "Engineering Mechanics and Strength of Materials" – Lakshmi Publications, Delhi 1990.

3. R.K. Rajput – "Strength of Materials', S. Chand & Company Ltd., New Delhi 1996.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply the concepts of action of forces on a body and should be able to apply the equilibrium concepts.
- Analyze any type of determinate trusses with different end conditions.
- To solve the sectional properties for any geometrical shapes.
- The concepts of elastic constants and its applications for various types of problems with a thorough understanding of stresses and strain.

TEXTBOOKS:

1. R.K.Bansal – A text book on Engineering Mechanics, Laxmi Publications, Delhi, 2005.

2. R.K.Bansal – A textbook on Strength of Materials, Lakshmi Publications, Delhi 2007.

REFERENCES:

1. P.C.Punmia, Strength of Materials and Theory of Structures; Vol. I, Lakmi Publications, Delhi 1994.

2. S. Ramamrutham, Strength of Materials – Dhanpatrai & Sons, Delhi, 1990.

3. W.A.Nash, Strength of Materials – Schaums Series – McGraw Hill Book Company, 1989.

4. R.K. Rajput – Strength of Materials, S. Chand & Company Ltd. New Delhi 1996.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Relate*** with basic engineering mechanics concepts required for analyzing static structures. To calculate resultant of parallel forces
CO2	***Solve*** the problems of Free body Diagram & principle of equilibrium
CO3	***Identify*** and model various types of loading and support conditions that act on structural
CO4	***Analyze*** any type of determinate trusses with different end conditions.
CO5	***Demonstrate*** the relations for centroid and Center of Gravity and ***Analyze*** the moment of
C06	***Apply*** the knowledge of stress and strain in the design of structural elements.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M			M	H	H		H
	CO2	L	H		M		M		M		L	H	L
	CO3					L						M	
	CO4	H	L			L		L		M		M	H
	CO5	H	M	M	M				M		H		H
	C06			h								l	
3	Category	Building sciences and Applied Engineering (BS & AE)											
4	Approval	30th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BMA 102	MATHEMATICS	3	0	0	3

OBJECTIVES:

- Identifying practical problems to obtain solutions involving trigonometric and exponential functions.
- Studying the properties of lines and planes in space, along with sphere and providing a tool too.
- Understand 3D material.
- Understand functions of more than one variable, along with differentiation under integral sign.
- Solving differential equation of certain type and analyzing data collection and interpretation of results using statistical tools.

UNIT I **9**

PLANE AND LINES

Direction rations and cosines of a line – equations of a plane and intersecting planes – symmetric form of a straight line – angle between lines and planes – coplanar lines – skew lines – shortest distance.

UNIT II **8**

CURVED SURFACES 8

Equations of Sphere – section by a plane – tangent plane – standard equations of cone, cylinder and conoid – Properties.

UNIT III **10**

MATRICES

Characteristic equation, values and eigen vectors of a real matrix cayley – Trigonom Theorem without proof, reduction of a real symmetric matrix to diagonal from.

UNIT IV **6**

INTEGRATION

Integration of rational, trigonometric and irrational functions, properties of definite integrals, reduction formulae for trigonometric functions.

UNIT V **12**

ORDINARY DIFFERENTIAL EQUATIONS AND FUNCTIONS OF TWO VARIABLES

Linear second order and higher order different equations with constant co effienients. Differential equations with variable coefficients of Euler type. Partial differentiation, total derivative, approximations, Taylor's theorem with remainder Maxima and Minima envelope.

TOTAL: 45 PERIODS

Text Book:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, Delhi

2. P. Kandhaswamy, K. Thilagavathi, "Engineering Mathematics" Vol – I & II, S. Chandhan Publishers – 1998.

2. Narayan S. Manickavachagam Pillai T.K. Ramanaiah G – "Advanced Mathematics for Engineering Students" – Vol I & II S. Viswanathan Printers – 1993.

References :

1. V.Ramamurthy – Engineering Mathametics – Vol I & II, Amudha publications

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Find*** area and volumes of simple, complex and irregular geometries using various rules.
CO2	***Apply*** Trignometry on architectural elements
CO3	***Demonstrate*** the appropriate role of the mathematical concepts learnt.
CO4	***Analyze*** Tally charts, Tables and graphs and statistical diagrams using for various types of data.
CO5	***Explain*** about various architectural proportioning systems and calculating the same.
C06	Understanding of the appropriate role of the mathematical concepts learnt

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2			M				M			L	H	L
	CO3		L			L						M	
	CO4	H				L	H			M			
	CO5			M	M				M		H	W	H
	C06		l					h					
3	Category	Basic Sciences (BS)											
4	Approval	31St Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BEN 102	ENGLISH	3	0	0	3

OBJECTIVES: The English Language Course for students of architecture would,

- Enhance their communication skills in English by developing their listening, speaking, reading and writing skills.
- Develop their speaking skills with specific reference to prospective/actual clients, suppliers, business partners and colleagues.
- Enhance their reading particularly, rules and regulations, catalogues, architecture journals and textbooks.
- Develop their writing skills especially writing emails, proposals and reports.

UNIT I **9**

LISTENING

Importance of listening, how listening plays a vital role listening comprehension - listening to audio cassettes – listening to interviews & group discussion and debate.

UNIT II **8**

SPEAKING

Defining things – Describing objects using adjectives – comparing – pronunciation practice –world stress – discourse markets – intonation – role play.

UNIT III **10**

READING

Detailed reading – interpreting tables, flow charts, tree diagram, pie diagram – understanding discourse coherence – guessing the meaning and training sentences (technical as well as general meaning) – vocabulary analysis.

UNIT IV **6**

WRITING

Sentence Patterns – SVO, SVOC, SVOCA…., recommendations and suggestions – preparing checklists, preparing an agenda to organize any program – formal and informal letters – preparing resume paragraph writing – note making and precise writing.

UNIT V **12**

LANGUAGES FOCUS

Parts of speech, prefixes & suffixes, degrees of comparison, prepositions, types of verbs, punctuation, error detection & correction synonyms and antonyms.

TOTAL: 45 PERIODS

Text Book:

1. "English for Engineers and technologist" Vil. I Orient Longman Ltd.

References:

1. Narayanasami, "Strength your writing"-Orient Longman revised edition.
2. Picket and laster, "Technical Writing" – New York Haper and Row publication.
3. Swan, Michel, "Basic English" – OUP
4. Technical communication – Principles – Meenakshi Raman & Sangeetha Sharma, Oxford University

COURSE OUTCOMES (COs)	
The student will be able	
CO1	*Identify* different strategies of reading and writing skills.
CO2	*Revise* the library skills in their learning process.
CO3	*Apply* different techniques to various types of material such as a novel, newspaper, poem, drama and other reading papers.
CO4	*Use* visual aids to support verbal matters into language discourse.
CO5	*Prepares* to face the written exam with confidence and without any fear or tension.
C06	Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M			M		H		H
	CO2			M	M	H					L	H	L
	CO3		L			L	L			M			
	CO4		L			L		H		M		M	
	CO5		M	M	M				M		H	W	H
	C06	L					M						
3	Category	Professional Ability Enhancement Courses (PAEC)											
4	Approval	30th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 1L2	ARCHITECTURAL GRAPHICS & ART STUDIO	0	0	6	3

OBJECTIVES:

- To understand drawing as a medium to visualize and communicate design ideas.
- To understand the concepts of Architectural Drawing with the introduction of drafting fundamentals.
- To understand the language of Architectural representations through Architectural Drawing systems and to introduce the basics of measured drawing.

UNIT I **9**

GEOMETRICAL DRAWING: INTRODUCTION

Introduction to fundamentals of drawing/ drafting: Construction of lines, line value, line types, lettering, dimensioning, representation, format for presentation, etc.; Construction of angles, use of scales; Construction of circles, tangents, curves and conic sections.

Fundamentals of art – Elements and principles of drawing – Types of drawing – Visual effects of drawing – Scale drawing – Composition – Approach to sketching – Study of light, shade and shadow.

Exercise involving Indoor and outdoor sketching – Spot sketching - Drawing from imagination –

Study of 3 D effects through light and shade from nature – Tools and materials – Illustration – Study of human being and mobiles.

UNIT II **8**

GEOMETRICAL DRAWING: PLANE & SOLID GEOMETRY

Construction and development of planar surface – square, rectangle, polygon etc Introduction of multi-view projection – projection of points, lines and planes.

Multi- view projection of solids – cube, prism, pyramids, cones, cylinders etc.; Sections of solids, true shape of solids.

UNIT III **10**

GEOMETRICAL DRAWING: AXONOMETRICPROJECTION & MEASURED DRAWING

Isometric, plan oblique and elevation oblique projection of planes, solids and combination of solid etc.

Introduction to fundamentals of measured drawing, line value, lettering, drawing representation, format for presentation methods and technique of measuring buildings and their details. Measured drawing of simple objects like furniture, detailing in terms of construction, ornamentation, measured drawing of building

components like column, door, window, cornice, etc

UNIT IV **6**

PAINTING I & II

Introduction of painting – Colour – Properties of colour – Colour schemes – Types of colours - Application and visual effects of colour. Exercise involving Study of colour – Properties of paper, brush and other tools – Basic washes – 3D effects from still-life, nature and built environment using mono chromatic and multi colour.

Indoor and outdoor painting – Rendering techniques Exercise involving Water colour – Water soluble colour pencil – Tempra – Acarali – Water soluble oil colour – Oil colour – Pen and ink –

Brush – Air brush – Mixed mediums – Study of multi colour and 3D effects from nature and built environment.

UNIT V SCULPTURE **6**

Introduction of sculpture –Sculpture using various materials such as clay, plaster of Paris, paper mache, and wire.

UNIT VI APPLIED ART **6**

Graphic representations – Visual composition and Abstraction- Exercises involving Logo design, collage, calligraphy and printing.

OUTCOMES

- An understanding on the concepts of architectural drawing as well as representation skills are imparted.
- An understanding on the building representation in 2D and 3D among students in addition to preparation of measured drawing.
- The students are exposed to various mediums and techniques.
- Bold enough to handle to the colours for the presentation sheets.
- The students are mastery in sketching and expression through forms.
- The skill and knowledge gained through the subject is most useful to their profession

TOTAL: 45 PERIODS

TEXTBOOKS:

1. IH. Morris, Geometrical Drawing for Art Students - Orient Longman, Madras, 2004.

2. Francis D. K. Ching, Architectural Graphics, John – Wiley and Sons, 2009.

3. Fraser Reekie, Reekie's Architectural Drawing, Edward Arnold, 1995

4. Webb, Frank, "The Artist guide to Composition", David & Charles, U.K., 1994.

5. Drawing a Creative Process", Ching Francis, Van Nostrand Reinhold, New York, 1990.

6. Alan Swann, Graphic Design School, Harper Collins,1991.

REFERENCES:

1. C.Leslie Martin, Architectural Graphics, The Macmillan Company, New York, 1978.

2. Moivahuntly, "The artist drawing book", David & Charles, U.K., 1994.

3. Arundell (Jan) Exploring sculpture, Mills and Boon, London/Charles, T. Brand Ford Company, U.S.A.

4. The art of drawing trees, heads, colours, mixing, drawing, landscape and painting,water colour, oil colour, etc. – The Grumbacher Library Books, New York –1996.

5. Caldwell Peter, "Pen and Ink Sketching", B.T. Bats ford Ltd., London, 1995.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Demonstrate*** the usage of various drafting tools in the process of preparing drawings.
CO2	***Assess*** 3D objects and represent them in drawings.
CO3	***Construct*** lines, Planar and solid geometry of simple and complex objects in reduced scales.
CO4	***Compare*** the various types of projections
CO5	***Construct*** Orthographic projections, Axonometric and Isometric views of three dimensional objects in reduced scales.
C06	An understanding on the concepts of architectural drawing as well as representation skills are imparted

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			L									
	CO2	H			H			M			L		
	CO3					M							L
	CO4		M	L	H		L					L	
	CO5									M			
	C06		M										
3	Category	Professional Core (PC)											
4	Approval	22nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 2 LI	ARCHITECTURAL DESIGN – II	0	0	11	6

UNIT I

DESIGN STUDIO

The problems involve simple space organization starting with single space single use – small span Horizontal movement – single bay – passive energy type spaces. The study of space standards and an anthropometrics related to each problem is stressed upon. Anthropometry as related to physically handicapped and elderly persons is required to be studies.

Examples and exercises include

a) Toilet for a physically handicapped person, Hostel Room, Bedroom, Kitchen.

b) Shop, Workshop, Pavilions, Snack bar.

c) Residence, Petrol bunk, fire station, police station, cottage for an elderly couple.

UNIT II WORKSHOP

Elementary models including wall surfaces floral designs, ceilings, glass areas; law water, bodies etc., Block models of small campuses using wood, the ramacol mount broad, soap, soap, corkboard, etc., Detailed model of a small building like branch bank, small residence, bus shelter, snack bar, including landscape details.

TOTAL: 180 PERIODS

References:

Design Studio

1. "E and O.E Planning", L life Book Ltd., London, 1973

2. De. Chiara and Callender, "Timer – saver standards for building types" McGrawHill Co., New York, 1973.

3. Sid Delk Mar Leach, "Techniques of Interior Design Rendering and Presentation", McGraw Hill Co., New York, 1973.

Workshop II

1. Wenninger (Magrus. J) "Sperical Models", Cambridge University Press, 1979.

2. Arundell (Jan), "Exploring Sculpture", Mills and Boom, London/Charles T. Brandford Company, USSA, 1972.

3. John W. Mills, "The Technique of Sculpture", B.T. Batsford Ltd., New York Reinhold Publishing Corpn., London, 1966.

4. Jannsen Constructional Drawing and Architectural models, KariKramer Verlag, Stuttgart

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Demonstrate the knowledge on arriving spatial requirements for various human activities
CO2	Demonstrate the knowledge on anthropometry and ergonomics in architectural design.
CO3	Interpret the case study examples to develop knowledge on architectural design.
CO4	Design of single spaces with the understanding of structural, utility, aesthetics and material considerations.
CO5	Develop a neat presentation drawings scale models using various media
C06	Learn to reciprocate and sensitize the design/concept to the environment and the design skill of the project

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			H	M			M	H	H		H
	CO2	L		M		H			M		L	H	L
	CO3					L				M		M	
	CO4		L			L				M			
	CO5	H	M	M	M				M		H		H
	C06					L						M	
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 201	THEORY OF ARCHITECTURE – II	3	0	0	3

OBJECTIVES:

- To introduce the large scale changes from 1960s as context for new thought in architecture.
- To give exposure to the critiques of modern architecture.
- To study in detail the different post modern directions in architecture.
- To give an outline of architectural approaches across the world from late 20^{th} century.
- To give an understanding of the trajectory of post independence architecture of India till the present.

UNIT I **9**

INTRODUCTION

Developments during the industrial area, the great inventions and the reason for the birth of modern architecture.

UNIT II **8**

USE OF NEW MATERIALS

Extensive use of steel, glass and concrete – the great or the international exhibitions and their influence on architecture. The characteristic feature of modern architecture.

UNIT III **10**

CONTEMPORARY ARCHITECTS

The various moments, thoughts and philosophies of the 19th and 20th centuries to include Art Nouveau, Brutalism, Chicago school, constructivism, expressionism, Bauhaus, Functionalism, futurism, Neoclassicism, Organic architecture, Modular Co-ordination.

UNIT IV **12**

CONTEMPORARY ARCHITECTS

The three generations of architects : first generation to include L. Sullivan, F.L. Wright, Le Corbusier, Mies Van Der Rohe, Eric Mendelson. Walter Gropius, Richard Neutra. Second generation to include, Erro Sarrinen, Kenzo Tange, Louis Kahn, Minoru Yamasaki, Hugh Stubbins, Paul Rudolph, Skidmore Owings and Merrill.

UNIT V **6**

LATER TREND

Developments of prefabrication techniques, futuristic thoughts of Buck Minister Fuller.

TOTAL: 45 PERIODS

References:

1. Peter Collins, “Changing ideals in Modern Architecture”, Faber and Faber, London, 1985.
2. Bill Rise Bero, “Modern Architecture and Design”.
3. Kenneth Frampton, “Modern Architecture – A critical history” – Oxford University Press, 1980.
4. William J. Christ “Modern architecture since 1900”, Paidon Press Ltd., Oxford, 1982.

COURSE OUTCOMES (COs)	
The student will be able	
CO	Understand the impact of literature in architecture on philosophical development of
CO	Understand concepts, material and construct the alternative architectural methods
CO	Exposed to the master architects works and trace the development of evolution of their
CO 4	Understand the spatial organization and spatial qualities of different typologies of buildings
CO	Knowledge of the contemporary design process and apply the same in the architectural
C0	Understanding the conceptualization of architectural design with respect to program,

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/PO	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				H	L	M		M		H	L	
	CO2				H	L	M		M		H		
	CO3				H	L	M		M		H		
	CO4				H		M						
	CO5				H		M						
	C06				H		M					L	
3	Categor	Professional Core(PC)											
4	Approva	37TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/ S	C
BAR 202	HISTORY OF ARCHITECTURE – II	3	0	0	3

OBJECTIVES:

- To give an overall understanding of the architecture in India up to the colonial period as parallel and sequential productions rising from the cumulative effect of forces operating and intersecting in the Indian subcontinent.
- To inform about specific and prominent modes of architecture in terms of evolution,
- Togive exposure to works that are architecturally exemplary and/or representative.
- To appreciate architecture as a giver of particular or universal meaning.

UNIT I **9**

ANCINET INDIA

Indus valley civilization – Culture and pattern of settlement. Impact of Aryan Culture – Vedic Village and the rudimentary forms of bamboo and wood wooden construction under the Mauryan Rule.

UNIT II **8**

BUDDHIST ARCHITECTURE

Hinayana and Mahayana Buddhism – Interaction of Hellenic & Indian ideas in Northern India – Architectural Production During Ashoka's Rule – Ashokan Pillar, Sarnath, Rock cut caves at Barabar, Sanchi Stupa, Salient features of a Chaitya hall and Vihara, Rock cut architecture in the Western and Eastern Ghats – Karli, Viharas at Nasik, Rani Gumpha, Udaigiri, Takti Bhai, Gandhara.

UNIT III **10**

HINDU ARCHITECTURE

Evolution of Hindu Temple – Early shrines of the Gupta and Chalukya periods – Tigawa Temple, Ladh Khan and Durga Temple, Aihole, Papanatha and Virupaksha Temples, Pattadakal.

UNIT IV **12**

DRAVIDIAN ARCHITECTURE

Dravidian culture – Rock cut products under Pallavas – Shore Temple, Mahabalipuram – Dravidian Order – Brihadeeswara Temple, Tanjore – Evolution and Form of Gopuram – Complexity in temple plan due to complexity in Ritual – Minakshi Temple, Madurai.

UNIT V **6**

INDO ARYAN STYLE

Salient Features of an Indo Aryan Temple – Lingaraja Temple, Bhuvaneswar – Sun Temple, Konarak, Kunds and Vavs – Sabali Kund – Adalaj – Surya Kund, Modhera.

TOTAL: 45 PERIODS

Test Book:

1. Percy Brown, "Indian Architecture (Buddhist and Hindu period)", Taraporevalla and sons, Bombay, 1983.

2. Satish Grover, "The Architecture of India (Buddhist and Hindu period)", Vikas Publishing Housing.

References:

1. Christoper Tadgelli, The History of Architecture in India From the Dawn of civilization to the end of Raj, Longman Group, U.K. Ltd., London, 1990.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the origin of various civilization and Architecture in India at different points of time
CO2	***Understanding*** the architectural responses with respect to materials, technology, style and character in the Buddhist, Hindu and Dravidian Architecture
CO3	***Understand*** the emergence of Islamic Architecture, form and function of different structures and the underlying geometry and concepts of decoration and colour.
CO4	***Gain Knowledge*** on the history related to design thinking, cultural aspiration, social needs, and the evolution of the built environment
CO5	An understanding of the diversity of architecture in India and sensitivity towards its syncretic aspects
C06	Ability to appreciate particular cultural, symbolic, spatial and material qualities in architecture and cities as givers of meaning and continuity.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2				M						L	H	
	CO3									M		M	
	CO4		L			L						M	
	CO5	H	M		M				M		H	W	H
	C06												
3	Category	Professional Core (PC)											
4	Approval	31St Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 203	MECHANICS OF STRUCTURES II	3	0	0	3

OBJECTIVES:

To enable understanding of the basic concepts of shear force and bending moment acting on beams subjected to different loading conditions.

- To give knowledge about how to determine stresses in beams and strength ofsections.
- To give knowledge about how to calculate deflection of beams.
- To enable study of theory of columns.
- To give an understanding of the concept of indeterminate structure and its analysis.

UNIT I **9**

SHEAR FORCE AND BENDING MOMENT

Concept of sharing forces and Bending Moments – shear force and bending Moment diagrams for cantilver and simply supported beams subjected to point load, uniformly distributed loads and their combinations.

UNIT II **8**

STRESSES IN BEAMS

Theory of simple blending stresses in beams, share stresses in beams – examples on simple sections. Stress distribution diagrams.

UNIT III **10**

DEFLECTION OF BEAMS

Slope and deflection at a section – Double Integration and Macaulay's method for simply supported and cantilever beams.

UNIT IV **12**

THEORY OF COLUMNS

Short and long columns – Euler's method and its limitation. Derivations of Euler's formula (for different end conditions) – Rankine's formula for columns, examples, effect of eccentric loading.

UNIT V **6**

INTRODUCTION INDETERMINATE STRUCTURES

Concept in Analysis of continuous beams, fixed, beams, cantilevers, and partial frames (No problems)

TOTAL: 45 PERIODS

Text Books:

1. M.M. Ratwani, & V.N. Vazirani, "Analysis of Structures, Vol. I" Khanna Publishers – Delhi, 1987.

2. A.R. Jain and B.K. Jain, "Theory and Analysis of Structures, Vol I" Nemchand and Bros, Roorkeee, 1987.

3. B.C. Punmia, 'Strength of Materials and Theory of Structures" Vol I Laxmi publications New Delhi, 1994.

4. R.K. Rajput "Strength of Materials", S. Chand & Company Ltd., New Delhi 1996.

References:

1. Timoshenko, S.P. and D.H. Young, "Elements of Strength of Materials" Fifth Editions, East West Press, 1983.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Identify*** various types of loading and support conditions that act on structural systems and Understand the basic principles used in the analysis of structural members.
CO2	***Apply*** the concepts for finding the shear forces and moments for various structural members.
CO3	***Apply*** the concepts for finding the shear forces and moments for various structural members.
CO4	***Analyze*** the long and short columns and determine the design loads.
CO5	***Analyze*** indeterminate beams like continuous beams and fixed beams
C06	***Analyze*** and solve the problems in practical installations of the structural members

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	H	M			M	H	H		H
	CO2			M							L		L
	CO3		L							M			
	CO4	H								M			
	CO5	H		M	M						H		
	C06					l		H					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BMA 204	PERSONALITY DEVELOPMENT, SOFT SKILLS ENHANCEMENT	3	0	0	3

OBJECTIVES

The objective of the training programme is bring about personality development with regard to the different behavioral dimensions that have far reaching significance in the direction of organizational effectiveness.

Unit 1 **9**

Leadership Introduction to Leadership, Leadership Power, Leadership Styles, Leadership in Administration.

Unit 2 **8**

Interpersonal skills – Conversation, Feedback, Feed forward

Interpersonal skills – Delegation, Humor, Trust, Expectations, Values, Status,

Unit 3 **5**

Communication Introduction to Communication, Flow of Communication, Listening, Barriers of Communication, How to overcome barriers of communication.

Unit 4 **6**

Stress Introduction to Stress, Causes of Stress, Impact Management Stress, Managing Stress

Unit 5 **6**

Group Dynamics Importance of groups in organization, and Team Interactions in group, Group Building Decision Taking, Team Building, Interaction with the Team, How to build a good team?

Unit 6 5

Time Time as a Resource, Identify Important Time Management Wasters, Individual Time Management Styles, Techniques for better Time Management.

Unit 7 **5**

Motivation Introduction to Motivation, Relevance and types of Motivation, Motivating the subordinates, Analysis of Motivation

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Students gets the ability to apply visual and verbal communication skills at various stages of architectural design and project delivery process.
CO2	Students gains self-confidence to get into the global world.
CO3	*Apply* different techniques to various types of material such as a novel, newspaper, poem, drama and other reading papers.
CO4	*Use* visual aids to support verbal matters into language discourse.
CO5	*Prepares* to face the written exam with confidence and without any fear or tension.
C06	Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2			M	M						L	H	L
	CO3									M			
	CO4	H	L							M		M	H
	CO5								M		H		H
	C06												
3	Category	Professional Ability Enhancement Courses (PAEC)											
4	Approval	22nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 205	ARCHITECTURAL GRAPHICS – II	3	0	0	3

UNIT I **15**

PERSPECTIVE

Characteristic of Perspective Drawings, Perspective Systems and methods. Two point perspective of simple objects, outdoor and indoor view of building etc.

UNIT II **15**

ONE POINT AND TWO POINT PERSPECTIVE

One and two point perspective of interiors, Perspective theory and practice.

UNIT III **15**

SCIOGRAPHY

Principles of shade and shadows – of lines and Circles, shadows of Architectural elements, etc., Shadows of circular solids, shadows on buildings.

TOTAL:45 PERIODS

Text Book:

I Perspective:

1. Robert W. Gill, “Basic Perspective”, Thames and Hudson, London, 1974.
2. Interiors: “Perspective in Architectural Design Graphic” – SMA Publishing Co., Ltd., Japan, 1967.

II Sciography :

1. C. Leslie Martin, “Architectural Graphics”, The Macmillan Company, New York, 1964.
2. Francis Ching, “Architectural Graphics”, Van Nostrand and Reinhold Company, New York, 1975.
3. Ernest Norling, “Perspective Drawing”, Walter Foster Art Books, California, 1986.
4. Bernard Alkins – 147, “Architectural Rendering”, Walter Foster Art Books, 1986.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Demonstrate*** the usage of various drafting tools in the process of preparing drawings.
CO2	***Assess*** 3D objects and represent them in drawings.
CO3	***Measure*** and prepare scaled measured drawings of various objects and existing buildings/
CO4	***Create*** One-point and Two-point perspective views of objects, interior and exterior of buildings from given plans and elevations.
CO5	***Analyze*** and ***draft*** the formation of shade and shadows of basic geometric shapes, forms and
C06	Ability to construct the 3d views and perspective drawings of the buildings.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		H	M			M	H	H		H
	CO2	L	H	M	M	H					L	H	L
	CO3		L			L				M		M	H
	CO4		L			L			M	M			H
	CO5	H	M	M	M				M		H	W	H
	C06					L		H					
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 206	MATERIALS AND CONSTRUCTION I	0	0	6	3

1 INTRODUCTION **15**

Functional requirements of a building and its components - Drawings of foundations, plinth superstructure, roofings. Soils - Formation - grainsize distribution - soil classification systems. Lime - fat/hydraulic limes - Their uses and properties - Manufacturing process -Mortar, functions - requirements - mix proportions.

2 RURAL - MATERIAL AND CONSTRUCTION **20**

Mud as a building material - Soil stabilisation, soil blocks-Drawings of foundations - types, S.S. Block - S.S.Castinsitu walls - flooring - roofing - plastering. Bamboo, casuarina coconut, palam, hay coir,jute-properties-uses-fire retardent treatment insection proofing. Types of foundations - walls - simple rooftrusses, floors for rural structures.

3 STONE **25**

Classification of rocks - Building stones - their uses - physical properties - brief study of tests for stone - deterioration - preservation of stone - various stone finishes - cutting and polishing of granites. Drawings of foundations - types of masonry - random rubble/Ashlar, etc.-cavity walls - flooring copings, sills, lintels,corbels, arches.

4 BRICKS AND CLAY PRODUCTS **15**

Bricks - brief study on manufacture of bricks - properties - uses - suitability - types of bricks - uses in buildings, structural titles, ceramics, terracotta - uses.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. R.J.S.Spencke and D.J.Cook, Building Materials in Developing Countries, John Wiley and Sons,1983.
2. HUDCO -All you want to know about soil stabilized mud blocks, HUDCO Pub., New Delhi, 1989.
3. UNO - Use of bamboo and reeds in construction - UNO Publications.
4. Rural Construction - NBO,New Delhi.

WEBSITES :

http://www.baboo-Flooring.com

http:// ag.avizona.edu/SWES

http://www/angelfite.com/in

http://www.idrc.ca/libary/documents/104800/chapz-e.html

http://www/angelfite.com/inz/granite

	COURSE OUTCOMES (COs)	
	The student will be able	
		Understand the basics of structures and differentiate their types. Know the formation of
		Get sensitized about the various ecological materials and their properties, treatment
		Draw the various types of building components for rural and modern structures using
		.Classify the various types of lime and compare their properties and application in building construction. Identify the mix
		Able to identify the good and clay products
		Identify the various water proofing materials, thermal insulation and their

Mapping of Course Outcomes with Program Outcomes (POs)

	C												
	C												
	C												
	C												
	C												
	C												
	C0												
	Ca	Building Sciences and Applied Engineering (BS &AE)											
	Ap	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 3LI	ARCHITECTURAL DESIGN – III	0	0	13	6

UNIT I

DESIGN STUDIO **120**

Single level planning in small scale, small span, horizontal movement and simple vertical movement, data collection, case studies, analysis and presentation of studies – Data collection with respect to design and detailing for physically handicapped persons – Concepts and presentation of design with scales models – Examples : Residential buildings, Institutional buildings, banks, Nursery or Primary schools, Primary Health Centre, School for children with learning disabilities, neighbourhood market, etc.

UNIT II

COMPUTER LAB STUDIO

Introduction to computer aided drafting system, concepts of real dimension, colours, symbols repeatability modification, layers, exercises related to design projects above.

TOTAL:210 PERIODS

References:

1. De Chiara and Callender, “Time Saver Standards Building Types”, McGraw Hill Co., 2nd Editions, 1980.

2. Edward D. Mills, Planning-“the Architects Handbook” – 10th Edition, British Library C Taloguing in Publishing Data, 1985.

3. Wakita / Linde, “The Professional practice of Architectural working, drawing” Jonh Wiley & Sons, 1984.

4. Andrew Alpern, “Handbook of specialty Elements in Architecture”, McGraw Hill Book Co., 1982.

5. Julius Panero & Martin Zelnik, “Human Dimension and Interior Space”, Whitney Library of Design Publication, 1979.

6. “Neufert Architect’s Data”, Rudolf Hefg, Crosby Lockwood and Sons Ltd., 1970.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand the characteristics of site and the importance of site planning which includes built form and open space.
CO2	Determine spatial arrangements, circulation of buildings and the response of user group through case studies.
CO3	Learn the process of design
CO4	Design of spaces with functional, aesthetics and material considerations by applying the knowledge gained in case studies.
CO5	Producing neat presentation drawings using various media and making scale models .
C06	Ability to perceive, understand and represent fundamental attributes of form-spacewith respect to human experience and use.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		H	M	H	M			M	H	H		H
	CO2			M								H	L
	CO3											M	
	CO4	H	L			L			M	M		M	
	CO5		M		M				M		H		H
	C06					M				L			
3	Category	Professional Core (PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 301	BUILDING SERVICES I	3	0	0	3

OBJECTIVES:

- To Study Water supply, treatments, distribution and plumbing system for all type of buildings.
- To Study Waste water treatments, Sewer lines for all types of buildings.
- To Study Drainage system for a Small Campus and a Residential neighbourhood.
- To understand Refuse collections, disposal, composting, Landfill, Bio gas for a Town and City.
- Applications of all the above systems to a Buildings, Small Campus and a Residential neighbourhood.

CONTENT:

UNIT I WATER QUALITY, TREATMENTS AND DISTRIBUTION 9

Sources of water supply – Water Quality - Water requirements for all type of residential, commercial, Industrial buildings and for town – Water treatment methods – Screening, aeration, Sedimentation, Filtration, Disinfection, Softening, conveyance of water – Distribution of water – Choice of pipe materials - Types of fixtures and fittings – System of plumbing in all type of buildings.

UNIT II WASTE WATER, TREATMENTS AND DISPOSAL 8

Waste water – Sewage disposal, primary treatment. Secondary treatment, Biological treatment and Modern types of Sewage Treatment Plants - Sewer line fixtures and traps, Manholes, Septic tank.

UNIT III STORM WATER DRAINAGE AND RAIN WATER HARVESTING 10

Basic principles of storm water drainage – drain pipes and type of pipe – storm water gutter –rain water harvesting principles – storage sumps

UNIT IV SOLID WASTE, COLLECTIONS, TREATMENTS, DISPOSAL, MODERN DRAINAGE SYSTEMS 12

Refuse collection, disposal, Incinerator, Composting, Vermicomposting, Sanitary Land filling, Bio gas system and Modern renewable energy system. Modern plumbing system, drainage collection system, disposal for a housing colony, small towns – Selection of pumps and Construction of pump rooms.

UNIT V APPLICATION OF THE ABOVE UNITS 6

Layout design and details of water supply distribution system in a Campus or Small residential neighbourhood - Layout design and details of sewage and drainage system for different types of buildings –

water supply pipe lines, storm water drainage pipe lines and Rain water Harvesting for small residential neighbourhood.

TOTAL: 45 PERIODS

OUTCOMES

1. Students have through understanding of how water and waste water are managed, in residential unit, small campus and for a large city.
2. Students are aware of the principles and best practices for Solid waste management in residential unit, small campus and for a large city.

TEXTBOOK:

1. Manual of water supply and treatment, Second edition, CPHEEO, Ministry of works and housing, New Delhi 1977
2. AFEWise, JASwaffiedWater, Sanitary &Waste Services in buildings –Mitchell Publishing Co. Ltd. – 2002, V Edition
3. Punmia B.C., Waste Water Engineering, Laxmi Publications, 2009.
4. Arceivala S.J., Waste Water Treatment for Pollution Control, Tata McGraw Hill, 2008.

REFERENCES:

1. G.M. Fair, J.C. Geyer and D.Okin, Water and Waste water engineering Volume II, John Wiley & Sons, Inc. New York, 1968
2. Manual on sewerage and sewerage treatment, CPHEEO – Ministry of works and housing, New Delhi, 1980
3. Renewable energy, basics and technology, supplement volume on integrated energy systems) Auroville, 1998 Sri Aurobindo Ashram, Pondicherry 605002 India

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Outline*** the sources and treatment of ground water
CO2	***Explain*** the various water supply and drainage systems
CO3	***Assess*** the water supply requirements and sewerage generated.
CO4	***Select*** the pumps, water supply and drainage pipes.
CO5	***Design*** the water supply and drainage layout of residential buildings.
C06	***Illustrate*** the solid waste management concepts and systems.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		H	M			M	H	H		H
	CO2			M	M						L	H	
	CO3									M			
	CO4					L				M			
	CO5	H	M	M	M				M		H		H
	C06												
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	34th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 302	HISTORY OF ARCHITECTURE – III	3	0	0	3

UNIT I **9**

ROMANESQUE

The medieval ages – learning in the monasteries, evolution of the guilds – Factors influencing architecture – outline of architectural character in Italy, France and England – Examples: Pisa group, Italy; Abbey Aux Hommes, Caen; Tower of London.

UNIT II **8**

FRENCH GOTHIC

Religious and social influence – evolution of vaulting and development of structural systems – outline of Architectural character – Examples: Notre Dame, Paris.

UNIT III **10**

ENGLISH AND ITALIAN GOTHIC

Development of English gothic vaulting – outline of architectural character in England and Italy – Examples: West Minister Abbey, Hampton Court Place, London: Doges Palace, Venice: Milan Cathedral.

UNIT IV **12**

ITALIAN RENAISSANCE

The Idea of rebirth and revival of art – sociological influences in art architecture – Development of thought, emergence of merchant communities and their patronage. Outline of the Architecture during the Early Renaissance. High Renaissance and Baroque Periods – Features of a typical Renaissance Place, example: Palazzo Ricardi, Study of life History, Philosophy, contribution of the following architects: Brunelleschi, Michael Angelo, and Andrea Palladio.

UNIT V **6**

FRENCH & ENGLISH RENAISSANCE

Outline of the architectural character of French and English Renaissance – Domestic Architecture in England – Study of the life, Philosophy and works of the following architecture: Sir Christopher Wren. Indigo Jones.

TOTAL: 45 PERIODS

Text Books:

1. Sir Bannister Fletcher, "A History of Architecture", University of London, The Antholone Press. 1986.

2. G.K.Hiraskar, Great Ages of World Architecture ,Dhanpat Rai and Sons,Delhi

References:

1. Pier Luigi Nervi, "History of World Architecture Series". Harry N. Abrame Inc. Publication, New York, 1972.

2. S. Lloyd/H.W. Muller, "History of World Architecture" – Series Faber Ltd., London, 1986.

3. Spiro Kostof, "A History of Architecture" – Settings and Rituals, Oxford University Press, London, 1985.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Explain the architectural characters of Medieval Europe through selected examples.
CO2	Analyze the continuity between each style – the factors that connect each style
CO3	Analyze the trend or the pattern of development of architectural styles.
CO4	Interpret the contemporary architectural style and its development leading to new styles.
CO5	Understanding Characteristics and styles of colonial architecture
C06	Understanding the ideas and styles over revolution.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M			M	H	H		H
	CO2			M							L	H	
	CO3									M			
	CO4		L			L				M			H
	CO5	H	M	M	M				M		H		H
	C06							M					
3	Category	Engineering Sciences (ES)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 303	DESIGN OF STRUCTURES I	3	0	0	3

OBJECTIVES: To introduce the design of various timber components in a building. • To enable the understanding of the types, efficiency and strength, advantages and
Disadvantages of Rivet and welded joints in steel. • To enable the design of Tension (beams) and compression (columns) steel members in a
building under various conditions.
• Case studies and models wherever applicable.

UNIT I

TIMBER STRUCTURES - DESIGN OF BEAMS AND COLUMNS 9

Grading of Timber – Permissible Stresses – Design of timber beams – Madras terrace roof – Design of timber columns.

UNIT II

STEEL STRUCTURES - BOLTED AND WELDED JOINTS 12

Assumptions – failure of Bolted joints – Strength and Efficiency of Bolted Joints – Types – Design of Bolted Joints for Axially Loaded Members (Excluding eccentric connections)Types of
welded joints – Advantages and disadvantages – Design of Fillet welds (Excluding eccentric connections).

UNIT III

TENSION MEMBERS 8

Introduction – Net sectional area – permissible stresses. Design of Axially loaded Tension member – Lug angle – code provision – tension splice.

UNIT IV

COMPRESSION MEMBERS 10

Introduction – various sections – built up section – Design of columns (excluding Lacing, Battening and other connections.)

UNIT V

STEEL BEAMS 6

Introduction – laterally supported and unsupported beams – Design of laterally supported beams.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

Design the timber beams and columns by applying the codal provisions. Able to design the steel joints for maximum efficiency and strength.

Tension members and compression members are designed for various conditions by applying the codal provisions.

Différent types of laterally unsupported & supported beams to be designed for various conditions.

TEXTBOOK:

1. L.S. Negi, Design of Streel Structures – Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

2. S. Ramachandra, Design of Steel Structures - Standard Book House, Delhi, 1984.

3. Ramamurutham .S, Narayanan .R, Design of Steel Structures, Dhanpat Rai – Sons, 2006.

4. Punmia B.C., Design of Steel Structures, Laxmi Publications, 2005.

REFERENCES:

1. A.S.Arya, Structural Design in Steel, Masonry and Timber, Nemchand and Bros, Roorkee, 1971.

2. National Building Code of India, 1983, Part VI, Structural Design.

3. Gurucharan Singh, Design of Steel Structures, Standard Publishers, New Delhi, 1982.

4. Dayaratnam.P, Design of Steel Structures, Oxford and IBH Publishing Co.

5. IS 883 – Code of Practice for Design of Structural Timber in Buildings

6. IS 800 - 2007 – Code of Practice for use of Structural Steel in General Building Construction

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Illustrate*** masonry walls for axial loads and RCC walls.
CO2	***Apply*** relevant IS Code provisions to ensure safety and serviceability of structural elements
CO3	***Identify*** and compute the main mechanical properties of concrete and steel and structural
CO4	**Design** different types of foundations for axially short and long columns
CO5	***Design*** reinforced concrete slabs and beams by WSM and LSM for flexure
C06	Ability to Differentiate types of laterally unsupported & supported beams to be designed for various conditions

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M			M	H	H		H
	CO2				M	H	L				L	H	L
	CO3		L			L		M		M			
	CO4		L			L				M			
	CO5	H	M	M	M				M		H	W	H
	C06					H		L					

COURSE CODE	COURSE TITLE	L	T	P/S	C
BMA 304	CLIMATE AND ENVIRONMENTAL STUDIES	3	0	0	3

OBJECTIVES:

- To study human heat balance and comfort.
- To familiarize students with the design and settings for buildings for daylight and factors that influence temperature
- To inform about the air pattern around buildings and the effect of wind on design and siting of buildings
- To expose the students to the various design strategies for building in different types of climatic zones.

UNIT I CLIMATE AND HUMAN COMFORT 9

Factors that determine climate of a place – Components of Climate – Climate classifications for building designers in tropics – Climate characteristics. Human body heat balance – Human body heat loss – Effects of climatic factors on human body heat loss – Effective temperature – Human thermal comfort – Use of C.Mahony's tables.

UNIT II DESIGN OF SOLAR SHADING DEVICES 8

Movement of sun – Locating the position of sun – Sun path diagram – Overhead period–Solar shading– Shadow angles – Design of appropriate shading devices

UNIT III HEAT FLOW THROUGH BUILDING ENVELOPE CONCEPTS 10

The transfer of heat through solids – Definitions – Conductivity, Resistivity, Specific heat,
Conductance, Resistance and Thermal capacity – Surface resistance and air cavities – Air to air transmittance (U value) – Time lag and decrement – Types of envelops with focus on glass.

UNIT IV AIR MOVEMENT DUE TO NATURAL AND BUILT FORMS 12

The wind – The effects of topography on wind patterns – Air currents around the building – Air movement through the buildings – The use of fans – Thermally induced air currents – Stack effect, Venturi effect – Use of court yard.

UNIT V CLIMATE AND DESIGN OF BUILDINGS 6

Design strategies in warm humid climates, hot humid climates, hot and dry climates and cold climates – Climate responsive design exercises.

TOTAL: 45 PERIODS

OUTCOMES

- Understanding of Thermal balance in Human beings
- Designing Climate responsive structure
- Conceptual understanding of Air flow in Buildings

TEXTBOOKS:

1. O.H. Koenigsberger and Others, Manual of Tropical Housing and Building – Part I - Climate design, Orient Longman, Madras, India, 2010.

2. Bureau of Indian Standards IS 3792 (1987), Hand book on Functional requirements of buildings other than industrial buildings, (Part I – IV), Manakbhavan, 9, Bahadur Shah Zafar Marg, New Delhi – 110 002.

REFERENCES:

1. Martin Evans (1980), Housing Climate and Comfort – Architectural Press, London.

2. B. Givoni (1981), Man, Climate and Architecture, Architectural Sciences Series – Applied Science Publishers Ltd., London

3. B. Givoni (1994) Passive and Low Energy Cooling of building, Van Nortrand Reinhold New York, USA.

4. Galloe, Salam and Sayigh A.M.M. (1998) "Architecture, Comfort and Energy", Elsivier Science Ltd., Oxford, U.K.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** climatic types and design approaches
CO2	***Analyze*** design types of shading devices
CO3	***Understand*** thermal performance of various building materials
CO4	Able to ***design*** of buildings with good ventilation
CO5	Able to ***design*** of climatic conscious buildings
C06	Designing Climate responsive structure

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		H	M			L	H	H		H
	CO2			M	L		L				L	H	
	CO3							L		M			
	CO4					L				M			
	CO5	H	M	M	M				M		H		H
	C06												
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	34th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 305	COMPUTER STUDIO – I	0	0	4	3

UNIT I

INTRODUCTION TO COMPUTER **15**

Technology of small computer system, computer terminology operation principles of P.C. introduction to application software, and graphic system, and use of printers, scanner, plotter, file management etc.,

UNIT II

INTRODUCTION TO COMPUTER AIDED 2D DRAFTING **15**

Understanding the use of drawing tools, object editing, drawing objects, filling and setting drawing units, scales, limits that size and dimensioning, text, Setting up of drawings of various simple architecture objects with complete text and dimensioning.

UNIT III

ADVANCE COMPUTER AIDED 2D DRAFTING **15**

Advance command programming – transparent overlays hatching utilities, assigned colour and line type, use of multiline, style, block, symbol library manipulation for accurate drawings, incorporating the above said utilities.

UNIT IV

INTRODUCTION TO 3D DRAFTING **15**

Introduction to 3D modeling technique and construction planes, drawing object 3D surface setting up elevation and thickness, and use of dynamic projections.

UNIT V

3D MODELLING **15**

Solid modeling with primitive commands and Boolean Operation. Use of region modeling in solid modification in solid modification.

TOTAL: 75 PERIODS

Text Book:

1. V. Rajaraman, "Principles of Computer Programming" – Prentice Hall of India.

References:

1. "Auto CAD reference manual" – Auto Desk Inc.

2. "Auto CAD Architectural users' guide" – Auto Desk Inc.

CO1	To **apply** softwares in the field of Architecture to represent design ideas.
CO2	***Produce*** 2D technical drawings using AutoCAD
CO3	***Develop*** the 3D model of buildings & objects using AutoCAD and Sketch Up
CO4	***Recreate*** realistic image of objects and buildings by using presentation software.
CO5	Sheet set ***organization*** and plot/print drawing to the scale.
C06	Ability to develop knowledge.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	H	M			M	H	H		H
	CO2			M	M	H					L	H	L
	CO3					L		M					
	CO4	H	L			L		M					
	CO5	H	M	M	M				M		H		H
	C06					L							
3	Category	ProfessinalAbilityEnhancement Courses (PAEC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 306	MATERIALS AND CONSTRUCTION II	2	0	4	4

UNIT I

BRICKS AND CLAY PRODUCTS **15**

Drawings of brick foundations - buildings in brickwork, bonds columns,corners - structrual members in brickwork. Reinforced brick masonry - Arches - Lintels - Corbels - copings. Hollow clay blocks - for walls - patritions -roofs. Roofings - Flats Roofs - or Terrace roofs - Sloping roofs. Detailing includes for physically handicapped.

UNIT II

TIMBER AND ALLIED PRODUCTS **15**

Softwood and Hardwood - Secondary Timber - Physical properties and uses - Defects, Conversion, Seasoning, Decay and preservation of timber - Fire retardent treatment, anti-termite treatment. Industrial timbers - plywood,blockboard,particle board, fibre boards. Manufacture and uses - current developments.

UNIT III

TIMBER **15**

Drawings of timber joinery for Windows, doors, ventilators. Timber partitions, panelling, false ceiling,fixed ceiling - wall panelling. Timber staircases - Designed staircase - timber trusses - Lean to - close couple - Kingpost - Queen pot - Trusses. Timber floors - timber built-in-furniture - Detailing and fittings for physically handicapped.

UNIT III

LOW COST BUILDING TECHNOLOGY **15**

Drawings of foundations - walling - Roofs - Partitions - Ceiling panel - Doors and Windows. Miscellaneous - Drawing of Brick Jails, Screen Walls - Pavement blocks - Ferrocement water tanks. Detailing and specifications for physically handicapped.

GLASS **15**

Composition of glass - brief study on manufacture, treatment, properties and uses of glass - special types of glass, sheet glass, plate glass, safety glass, tinte coated glass - Glass blocks - properties and applications in the building Industry -current developments.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Don A.Watson, Construction Materials and Processes, McGraw Hill Co.,1972.

2. Alanwerth, Materials, The Mitchell Pub.Co.Ltd., London,1986.

3.R.Chudleu,'Building Construction Handbook',British Library Cataloguing in Publication Data,London,1990.

WEBSITES

http://www.ibex-ibex-intl.com

http://www.inika.com/chitra

http://www.routbdge.com

http://www.ventura india.com

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the basics of structures and differentiate their types. Know the formation of soil, their classification and understand the importance of soil in building construction.
CO2	Classify the various types of timber and compare their properties and application in building construction.
CO3	Draw the various types of building components for rural and modern structures using various materials like timber
CO4	Classify the various types of stones and bricks and compare their properties and application in building construction.
CO5	Draw the various types of building components for rural and modern structures using various materials like brick, stone.
C06	Able to identify the good and clay products

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		H	M			M	H	H		H
	CO2			M	M						L	H	
	CO3									M			
	CO4					L				M			
	CO5	H	M	M	M				M		H		H
	C06												
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 4LI	ARCHITECTURAL DESIGN – IV	0	0	13	6

UNIT I

DESIGN STUDIO

Problem related to multi room, single use, small span – Multiple story, Horizontal and vertical movement, Active cum passive energy, Masonry and frame type buildings.

Ex: Department store, Library, higher secondary school, campus students' center, etc. The projects will consciously provide for movement and use by the physically handicapped and elderly.

UNIT II

DESIGN STUDIO – RURAL PROJECT

Problems related to Rural Housing – Visits to selected village – Surveys on socio – economic, physical, housing and surveys, etc. to study existing conditions – analysis of survey data – preparation of report and presentation in a seminar – preparation of design brief solutions for housing and community facilities.

UNIT III

COMPUTER LAB STUDIO

Documentation of rural project of Housing typology using computer – Introduction to 3D modeling and rendering 3D images. **TOTAL: 180 PERIODS**

References:

1. De Chiara and Callender, "Time Saver Standard for building Types". McGraw Hill Co., 2nd Edition 1980.

2. Edward. Mills, Planning – "The Architects handbook – 10th Edition", British Library Cataloguing in Publication Data, 1985.

3. Wakita Linde, "The Professional Practice of Architectural Working", Drawing John Wiley & Sons 1984.

4. Andrew Alphern "Handbook of Specialty Elements in Architecture", McGraw Hill Book Co.,

5. Julius Panero & Martin Zelnik, "Human Dimension and Interior Space", Whitney Library of Design Publication, 1979.

6. "Neufert Architect's Data", Rudolf Herg, Crosby Lockwood and Sons Ltd., 1970.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the space and furniture's required for various human activities.
CO2	***Interpretation*** of buildings for spatial arrangements and circulation.
CO3	***Design*** of medium scale public buildings with structural, utility, aesthetics and material considerations by applying the knowledge gained in case studies. Analyse a site with respect to various aspects
CO4	Learn the procedure of studying and **analysis** of rural housing and settlements and preparing design solutions.
CO5	***Involve*** in producing neat presentation drawings using various media like pencil color, water and poster colors, crayons etc.
C06	***Prepare*** scale models of studio exercises using sheets, boards, wood etc.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M			M	H	H		H
	CO2			M	M	H					L	H	L
	CO3	H				L		H		M		M	H
	CO4		L			L	L			M			
	CO5		M	M	M				M		H		
	C06							H					L
3	Category	Professional Core (PC)											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 401	BUILDING SERVICES II	3	0	0	3

UNIT I **9**

PUMPS AND MACHINERIES

Reciprocating, centrifugal, deep well, submersible automatic pumps, sewerage pump, compressors vacuum pump – their selection installation and maintenance – Hot Water Boiler –Lifts and Escalators – special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC / AC motors – generators – Laboratory services – gas, water, air and Electricity.

UNIT II **8**

ELECTRICAL SYSTEMS

Basics of electricity – single / three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI Specification.

UNIT III **10**

ELECTRICAL INSTALLATIONS IN BUILDINGS Type of wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – transformers and switch gears – Layout of substations.

UNIT IV **12**

PRINCIPLES OF ILLUMINATION

Visual Tasks – factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – additive and subtractive synthesis of colour – luminous flux – Candela – Solid angle illumination – Utilisation factor – depreciation factor – MSCP – MHCP – Lans of illumination.

UNIT V **6**

LIGHT DESIGN

Classification of lighting – Artificial light sources – spectral energy distribution – luminous efficiency – colour temperature – colour rendering. Design of modern lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination requited for physically handicapped and elderly in building types.

TOTAL: 45 PERIODS

Text Books:

1. “Handbook for Building Engineering in Metric systems”, NBC, New Delhi, 1968.

References:

1. E.R. Ambrose, "Hear Pumps and electric heating", John and Wiley and Sons, Inc., New York, 1968.
2. "Philips Lighting in Architectural Design", McGraw Hill, New York, 1964.
3. R.G. Hopkinson and J.D. Kay, "The Lighting of buildings", Faber and Faber, London, 1969.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Illustrate*** the basics of electricity, components and installations and ***prepare*** electrical layout
CO2	***Illustrate*** the fundamentals of lighting and ***prepare*** lighting design
CO3	***Outline*** energy efficient lighting design solutions
CO4	***Understand*** the fire safety requirements of buildings
CO5	***Identify*** fire detection and fire fighting systems for buildings and ***prepare*** fire safety
C06	

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H	L	H	M			M	H	H		H
	CO2	L		M	M						L	H	
	CO3						M	L		M		M	
	CO4					L				M			
	CO5	M			M				M		H		H
	C06												
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 402	HISTORY OF ARCHITECTURE – IV	3	0	0	3

UNIT I **9**

INTRODUCTION TO ISLAMIC ARCHITECTURE

Brief History of Islam in terms of birth, spread across countries and principles – Influences on Islamic Architecture – Evolution of building types in terms of forms and functions – the mosque, the tomb, and minaret, the madarasa, the palace, the caravanserai, vernacular architecture, the market – important principles, elements and character of Islamic architecture in terms of structure materials and methods of construction, elements of decoration, colour, geometry, light – important examples to illustrate development of Islamic architecture.

UNIT II **8**

ISLAMIC ARCHITECTURE IN INDIA

Advent of Islam into the Indian subcontinent and its impact – source of Islamic Architecture in India and influences on them – Brief history of development and classification urban different styles and regions.

UNIT III **10**

DELHI OR IMPERIAL STYLE

Development of architectural styles during the rule of the slave, Khilji, Tulip Spayed and Lodi Dynasties – important examples for each period.

UNIT IV **12**

PROVINCIAL STYLE

Development of the provincial styles in different regions – Punjab, Jaunpur, Bengal, Gujarat, Malwa, the Deccan (Bijapur, Golconda, Bidar and Gulbarga) – Important examples for each style.

UNIT V **6**

MUGHAL STYLE

Development of the Mughal style under the different rulers – Babur, Shershah, Humayun, Akbar, Jahangir, Shahjahan, Aurangzeb – important examples – development of the Mughal garden – important examples.

TOTAL: 45 PERIODS

Text Books:

1. Brown Percy, “Indian Architecture (Islamic Period)” Taraporevalla and Sons, Bombay, 1983.
2. Satish Grover .The Architecture of India(Islamic) Vikas Publishing House Pvt Ltd. New Delhi

References:

1. "Architecture of the Islamic World" – George Michell – its history and social meaning, Thames and Hudson, London, 1978.

2. "Islamic Architecture, Form, Function and Meaning", Robert Hillenbrand, Edinburgh University Press, 1994.

3. Christopher Tadgell – "The History of Architecture in India" – Penguin Books (India) Ltd., New Delhi, 1990.

4. Satish Grover, "The Architecture of India (Islamic)" Vikas Publishing House Pvt. Ltd., elk New Delhi, 1981.

5. R. Nath – "History of Mughal Architecture" – Abhinav Publications – New Delhi – 1985.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the origin of various civilization and Architecture in India at different points of time
CO2	***Understanding*** the architectural responses with respect to materials, technology, style and character in the Buddhist, Hindu and Dravidian Architecture
CO3	***Understand*** the emergence of Islamic Architecture, form and function of different structures and the underlying geometry and concepts of decoration and colour.
CO4	***Gain Knowledge*** on the history related to design thinking, cultural aspiration, social needs, and the evolution of the built environment
CO5	An understanding of the diversity of architecture in India and sensitivity towards its syncretic aspects
C06	Ability to appreciate particular cultural, symbolic, spatial and material qualities in architecture and cities as givers of meaning and continuity.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2				M						L	H	
	CO3									M		M	
	CO4		L			L						M	
	CO5	H	M		M				M		H	W	H
	C06												
3	Category	Professional Core (PC)											
4	Approval	31st Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 403	DESIGN OF STRUCTURES II	3	0	0	3

OBJECTIVES:

- To inform about the methods of design through working stress and limit state methods.
- To use the above two methods for the design of Concrete beams and slabs under various conditions.
- To use the limit state method for design of a concrete staircase.
- Case studies and models wherever applicable.

UNITI **9**

DESIGN OF CONCRETE MEMBERS AND WORKING STRESS

DESIGN OF BEAMS

Concept of Elastic method, Ultimate Load Method and Limit State Method – Advantages of Limit State Method over other methods. Analysis and Design of Singly and Doubly reinforced rectangular and flanged beams for bending.

UNITII **8**

LIMIT STATE DESIGN OF BEAMS

Analysis and design of singly and doubly reinforced rectangular and flanged beams for Bending – Design of Continuous beams using IS code co-efficient.

UNIT III **10**

LIMIT STATE DESIGN OF SLABS

Behavior of one way and two way slabs – Design of one way and two way slabs for various edge conditions - Corner effects.

UNIT IV **12**

DESIGN OF CIRCULAR SLABS

Design of Simply supported and fixed Circular slabs subjected to uniformly distributed loads.

UNIT V **6**

DESIGN OF STAIRCASE BY LIMIT STATE METHOD

Types of Staircases – Design of Dog Legged Staircase.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the different concepts of WSM and LSD methods using the codal provisions.
- RC beams and slabs to be designed by applying the above concepts.
- Dog legged staircase design using LSD.

TEXTBOOK:

1. S.N. Sinha, Reinforced Concrete Design – Tata McGraw Hill Publishing Co. Ltd.,New Delhi,1998.

2. Shah, Reinforced Concrete, Vol. 1 and 2 – Charotar Publishing House, Anand, 1998.

REFERENCES:

1. P.Dayaratnam, Design of Reinforced Concrete Structures, Oxford and IBH Publishing Co., 1983.

2. C. Sinha and S.K. Roy, Fundamentals of Reinforced Concrete, S.Chand & Co., New Delhi, 1983.

3. Dr. B.C. Punmia, Reinforced Concrete Structures, Vol, 1 & 2 Laxmi publication, Delhi, 2004.

4. IS 456:2000, Indian Standard, Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards.

5. S. Unnikrishnan Pillai and Devados Menon, Reinforced Concrete Design – Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1999.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Design*** the Pre stressed members
CO2	***Explain*** the design concepts of Shells and folded plates
CO3	***Analyze*** the behavior of steel and R.C.C structural members
CO4	***Design*** the steel connections.
CO5	***Design*** the R.C.C structural members
C06	Understand the different concepts of WSM and LSD methods using the codal provisions

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H	M	H	M			M	H	H		H
	CO2					H					L	H	
	CO3					L	H					M	
	CO4	L	L			L							
	CO5	L	M	M	M				M		H		H
	C06				L		M						
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 404	SITE PLANNING & LANDSCAPE ARCHITECTURE	0	0	4	3

OBJECTIVES:

- To teach the importance of site and its content in architectural creations
- To orient the students towards several influencing factors which govern the siting of a building or group of buildings in a given site.
- To teach various techniques of site analysis through exercises and case studies.
- To teach the students the methodology of preparing a site analysis diagram. This will serve as a prelude to any architectural creation through exercises.

UNIT I **9**

INTRODUCTION

Definition of plot, site, land and region, units of measurements. Introduction to survey, methods of surveying, where they are used, Surveying Instruments and their application. Need for surveying. Measuring and drawing out a site plan from the measurements

UNIT II **8**

SITE DRAWINGS

Computation of area by geometrical figures and other methods. Drawing marking out plan, layout plan and centerline plan – Importance, procedure for making these drawings and dimensioning. Setting out the building plan on site – Procedure and Precautions. Exercises on the above.

UNITIII **12**

SITE ANALYSIS

Importance of site analysis; On site and off site factors; Analysis of natural, cultural and aesthetic factors – topography, hydrology, soils, vegetation, climate, surface drainage, accessibility, size and shape, infrastructures available - sources of water supply and means of disposal system, visual aspects; Preparation of site analysis diagram. Study of microclimate:- vegetation, landforms and water as modifiers of microclimate. Study of land form;- contours, slope analysis, grading process, grading criteria, functional and aesthetic considerations – Case studies and exercises on the above.

UNITIV **10**

SITE CONTEXT

Context of the site. Introduction to existing master plans land use for cities, development control Rules. Preparation of maps of matrix analysis & composite analysis. Site selection criteria for housing development, commercial and institutional projects - Case studies.

UNIT V **6**

SITE PLANNING AND SITE LAYOUT PRINCIPLES

Organization of vehicular and pedestrian circulation, types of roads, hierarchy of roads, networks, road widths and parking, regulations. Turning radii & street intersections

TOTAL: 45 PERIODS

OUTCOMES

- The contextual importance on site analysis can be understood based on the various site factor with respect to the study area.
- A first hand understanding of site drawings for Landscape Architecture and Urban design is
- studied.
- Various scientific and analytic site analysis techniques is understood.
- A methodological approach for preparation of master plans for small scale and large scale projects can be understood.

TEXTBOOK:

1. Kevin Lynch - Site planning - MIT Press, Cambridge, MA - 1984.

2. Edward. T. Q. Site Analysis – Architectural Media, 1983

REFERENCES:

1. B.C.Punmia - Surveying Vol.I - Standard Book House, New Delhi - 1983.

2. P.B.Shahani - Text of surveying Vol.I, Oxford and IBH Publishing Co – 1980

3. Joseph De.Chiarra and Lee Coppleman - Urban Planning Design Criteria – Van Nostrand Reinhold Co., 1982

4. Storm Steven, Site engineering for landscape Architects, John wiley & Sons Ine, 2004.

5. Development Control Rules – CMDA, 2008.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Illustrate the application of various types of surveys in buildings
CO2	Survey a site or building
CO3	Analyse a site with respect to various aspects
CO4	Design and Develop a site plan
CO5	Outline the Environmental factors related to site planning
C06	Understand the Sensitivity towards aspects of site at macro and micro contexts.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2	L		M		H					L	H	L
	CO3									M			
	CO4		L							M			
	CO5	H	M		M				M		H		H
	C06						L					M	
3	Category	Professional Core (PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 405	CLIMATE & BUILT ENVIRONMENT	3	0	0	3

OBJECTIVES:

At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I **9**

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Definition, scope and importance of environment – need for public awareness - Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill /mountain.

UNIT II **8**

ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the

(a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems

(ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographically classification of India

– value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option

values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hotspots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNITIII **10**

ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV **12**

SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

– wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V **6**

HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

1. Students are sensitized on the need for natural resource management, and sustainable lifestyles
2. Students appreciate the value of ecosystem and the need and methods for conserving the same.
3. Students understand the how pollution and hazards can be mitigated.

TEXT BOOKS:

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
2. Erach Bharucha, "Text book of Environmental Studies", University Press, Hyderabad, 2006.
3. Anubha Kaushik and Kaushik C.P., " Perspectives in Environmental Studies" New age International (P) Ltd., New Delhi, 2005
4. Venugopala Rao.P, " Principles of Environmental Science and Engineering" Prentice Hall of India Pvt. Ltd., New Delhi, 2006.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi,2007
3. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press,2005
4. Richard T. Wright, "Environmental Science" Prentice Hall of India Pvt. Ltd., New Delhi,

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand what constitutes the environment and how to conserve it.
CO2	To analyse the need for natural resource management, and sustainable lifestyles
CO3	To evaluate the value of ecosystem and the need and methods for conserving the same.
CO4	To understand the how pollution and hazards can be mitigated.
CO5	To analyse with case studies on various social causes and understand the need to spread and learn more about the causes and the ways to prevent them.
C06	An overview of important regulations and bylaws

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	H	M				H	H		H
	CO2			M					M		L	H	L
	CO3					L		H		M		M	
	CO4					L	L			M		M	
	CO5	H	M		M				M		H		H
	C06						M						
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 406	MATERIALS AND CONSTRUCTION III	2	0	4	4

OBJECTIVES:

- To give an introduction to cement and concrete as materials for building construction.
- To help understand the principles, types, methods of construction and applications of concrete for structural and non-structural building components.
- To enable design and detail using concrete in buildings

1 CEMENT **10**

Varities of cement,compostion,properties and uses - brief study on manufacture of portland cement - tests for cement - mortar for various works.

2 CONCRETE,ITS INGREDIENTS MANUFACTURE & PROPERTIES **15**

Ingredients - suitability requirementsd for aggregates, grading of aggregates - role of water in concrete - reinforcement - admixtures - properties of concrete. Manufacture of concrete and concreting - mix proportioning - batching, mixing, transporting, placing, compaction, curing formwork - quality control - outline of tests for concrete - joints in concrete - concrete finishes.

3 SPECIAL CONCRETE AND CONCRETING METHODS **15**

Lightweight, high density, fibre reinforced, polymer concrete - outline of manufacture, properties and uses of the above - ready mixed concrete - grunting - cold weather and underwater concreting - current developments in concrete products and methods of concreting.

4 CONCRETE CONSTRUCTION **15**

Introduction to frames structures.

Concrete in foundations - types of footings - isolated, combines, continious,strip. Concrete floors, walls and partitions. Concrete Lintels, arches, sunshades Concrete slabs - types - concrete beams and columns.

5 CONCRETE STAIRCASES **20**

Factors involving staircase design - types of staircases like straightflight, doglegged, quarterturn, bifurcated,spiral,helical, etc. - different support conditions like inclined slab,cranked slab,continuous,cantilever - foundations, finishes for staircases- detailing out of handrails and balusters. Designing and detailing for physically handicapped.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. M.S.Shetty, Concrete Technology, S.Chand & Co.ltd,New Delhi,1986.
2. S.C.Rangwala, Engineering Materials, Charotar Publishing House, India, 1997.
3. Dr.B.C.Punmia, Building Construction, Laxmi Publications Pvt.Ltd., New Delhi, 1993.
4. Arthur Lyons - Meterials for Architects and Builders - An introduction Arnold, London,1997.
5. Don A.Watson, Construction Materials and Process, McGraw Hill Co.,1972.
6. Jack M.Launders, Construction Materials and Methods Careers, South Holland, Illinois, Wilcox Co.Ltd.,1986.
7. Francis D.K.Ching, Building Construction Illustrated VNR.1975.
8. Alan Banc, Stairs, Steps and Ramps, Butterworth Heinemann Ltd.,1996.

WEBSITES:

http://dir.yahoo.com/Business-and -
Economy/companies/construction/concrete/materials

http://www.easyads.co.2a/yellow/india/construct

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Explain*** the composition, properties, and tests for cement
CO2	***Summarize*** the ingredients, properties ,quality control of concrete and its construction process
CO3	***Create*** detailed drawings of footing, lintels, beams and slabs
CO4	Ability to use concrete as a versatile material in different contexts and to use it innovatively in simple projects.
CO5	An understanding of the concepts of concrete as a building construction material
C06	Ability to design and detail specific components in concrete where there is scope for architectural design.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2			M	M						L		L
	CO3									M			H
	CO4		L			L	H			M		M	H
	CO5		M	M	M				M		H	W	H
	C06	H				M		L					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 5LI	ARCHITECTURAL DESIGN – V	0	0	13	6

UNIT I

DESIGN STUDIO

Small complexes – multi planning circulation analysis – massing problems involving building technology – Design and detailing for movement of physically handicapped and elderly persons within and around buildings, examples, shopping center (Commercial) apartments (Residential) Nursing home (Institutional) home for aged. Introduction to three dimensional modeling of spaces using computer. Construction and manipulation of three dimensional building data bases, Rendering 3D images, Presentation techniques.

TOTAL:180 PERIODS

References:

1. Edward D. Mills, "Planning, 4 volumes", Newnes, Butterworths, London, 1976.
2. E and O.E. "Planning", Liffee Books Ltd., London, 1973.
3. "National Building Code" IST
4. De Chiara Callender, "Time Saver Standard for Building Types", McGraw Hills Co., 1973.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Demonstrate*** the concept of passive design in built environment
CO2	Ability to critically understand and address issue of resources.
CO3	***Analyze*** the impact of spatial configuration at building level and at site level on passive design.
CO4	***Analyze*** and interpret different case buildings.
CO5	***Design*** and development energy efficient buildings.
C06	***Develop*** working drawings and model displaying energy efficient and green building technologies.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M			M	H	H		H
	CO2			M	M						L		
	CO3									M			H
	CO4		L			L	H			M		M	
	CO5		M	M	M						H		H
	C06	H				M		L					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	25th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 501	BUILDING SERVICES III	3	0	0	3

UNIT I **9**

BASIC REFRIGERATION PRINCIPLES

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent of fusion, evaporation, sublimation – Saturation temperature – Super heated vapor – sub cooled liquid pressure temperature relationship for liquids – Refrigerants.

UNIT II **8**

REFRIGERATION CYCLE AND SYSTEM COMPONETNS

Vapor compression cycle – compressors – evaporators – Refrigerant control devices – electric motors – starters – Air handling units – Cooling towers.

UNIT III **10**

AIR-CONDIONING SYSTEM AND APPLICATIONS

Window type and package air-conditioners – chilled water plant – fan coil systems – water piping – cooling load – Air-conditioning systems for different types of buildings –Protection against fire to be caused by A.C. systems.

UNIT IV **12**

FIRE SAFETY – GENERAL PROVISIONS

Causes of fire in buildings – safety regulations – NBC – Planning considerations in buildings like Non-combustible materials, construction, staircase and life lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types.

UNIT V **6**

FIRE DETECTION AND FIGHTING INSTALLATIONS

Heat and smoke detectors – Fire Alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and Wet risers – Automatic sprinklers.

TOTAL: 45 PERIODS

Text Books:

1. William H. Severns and Julian R. Fellows, "Air conditioning and Refrigeration", John Wiley and Sons, London, 1988.

References:

1. A.F.C. Sherratt. "Air conditioning and Energy Conservation", The Architectural Press, London.

2. "National Building Code".

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Illustrate*** the basics of building management systems, scope and its importance.
CO2	***Outline*** the basics of BIM and Controllers.
CO3	***Categorize*** all the aspects of BMS and its role in advanced building services.
CO4	***Assess*** the components of BMS and its application in buildings
CO5	***Summarize*** the various technological advancements, current trends in BMS
C06	Ability to integrate services in buildings.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2			M	M	H					L		L
	CO3					L				M			H
	CO4		L			L	H			M		M	H
	CO5		M	M	M				M		H	W	H
	C06	H				M		L					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/ S	C
BAR 402	HISTORY OF ARCHITECTURE – V	3	0	0	3

UNIT I **9**

LEADING TO A NEW ARCHITECTURE

Historical overview – Origins if Neo-Classicisms – Enlightenment Architects: Boulle and Ledoux. Beginning of New Extra – Industrial Revolution & its impart – Materials & Technology's History of Steel concrete glass.

UNIT II **8**

REVIEWING INDUSTRIALIZATION

Architecture Industrial Exhibition Arts and Crafts Movement in Europe and America – Art Nouveau and the works of Gaudi, Horta, Guimard, Macintosh – Early works of F.L. Wright.

UNIT III **10**

ISSUES OF ORNAMENTATION AND AESTHETICS

Adolf loos and the Arguments on Ornamentation – Futurists Movement Manifestos and the works of Sant Elia – Expressionism and the works of Mendelssohn, Taut, Polzeig – Cubism and Constructivism and its influence on Architecture – De stijl : Ideas and works.

UNIT IV **12**

INSTITUTIONS

Werkbund and Bahaus/Works of Behrens and Gropius – Cannonising Modernism – International Style – CIAM Congresses and Declarations.

Works and Ideas – Le Corbusier – Mies – Later Works of Wright – Alvar Alto.

UNIT V **6**

ARCHITECTURE IN COLONIAL INDIA

Colonialism and its impact – Early British Neo – classical Architecture – Indo – Sarcenic Architecture and the works of Chisholm – P.W.D. and the Institutionalisation of Architecture – Building New Delhi.

TOTAL: 45 PERIODS

Text Books:

2. Mechy Design – "Architecture after Independence".

References:

1. Leonardo Benevolo, “History of Modern Architecture”, 2 Vols. Routledge & Kegan Paul, London, 1971.

2. Manfredo Taferi/Franceso dal co., “Modern Architecture”, Faber and Faber / Electra, 1980.

3. Sigfried Giedion, “Space Time and Architecture”. The Growth of a New Tradition, Harvard University Press, 1978.

4. Thomas Metcalf, “An Imperial Vision”, Faber and Faber, London. 1989.

5. Tzonis Alexander – Santiago Calatrava International Publication

6. Kenneth Frampton, “Modern Architecture”. A Critical History, Thames and Hudson, London 1994.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Differentiate*** the chronological development of architectural style in relation with the material development and cultural change.
CO2	***Interpret*** the spatial configuration and three dimensional articulation of master architects
CO3	***Examine*** the contextual design solution, Spatial organization and spatial qualities of different typologies of buildings.
CO4	***Develop*** the knowledge towards logical design development.
CO5	An understanding of modernity as a fundamental transformation in Western society that spread across the world and the resultant architectural production.
C06	An insight into the development of modern architecture.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	M			M	H	H		H
	CO2	L	H	l	M	H					L	H	L
	CO3	H	L			L		L	L	M		M	l
	CO4	H	L			L	M		M	M		M	H
	CO5	H	M	M	M				M		H	W	H
	C06					L							

3	Category	Professional Core (PC)
4	Approval	29th Meeting of Academic Council

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 503	DESIGN OF STRUCTURES III	3	0	0	3

OBJECTIVES:

- To inform about structural design through working stress and limit state methods.
- To enable use of the above two methods for the design of concrete beams and slabs under different conditions.
- To enable use of limit state method for design of a concrete staircase.

UNIT I **9**

LIMIT STATE DESIGN OF RCC COLUMS

Code provisions – design of axially loaded short and long columns of rectangular and circular sections – ties and spiral reinforcements.

UNIT II **8**

LIMIT STATE DESING OF BEAMS, SLABS AND STAIRCASE

Limit state design of continuous beams and slabs using code coefficients. Types of staircases – design of doglegged staircase.

UNIT III **10**

SEISMIC STUDY AND STRUCTURAL APPLICATION IN BUILDING DESIGN

Introduction of seismic study – identification of seismic zones – effects of earthquake in environment and in built forms – types of structural damages due to seismic effects – precautions in structural design – form and shapes of built forms and structures. Materials related to structural forms – related building codes – safety factors.

UNIT IV **12**

WORKING STRESS DESIGN OF FOUNDATION

Types of foundation – isolated pad footings – combined footings – design principles for rafts, pile foundations. (No design calculations)

UNIT V **6**

WORKING STRESS DESIGN OF RETAINING WALLS

Design of RCC Cantilever retaining walls

TOTAL: 45 PERIODS

Text Books :

1. P. Dayaratnam, “Design of Reinforced Concrete Structure”, Oxford and IBH Publishing Co., 1983.

2. N.C. Sinha and S.K. Roy, Fundamentals of Reinforced Concrete’, S. Chand and Co., New Delhi, 1983.

References:

1. Vazirani and Ratwani, 'Concrete Structures', Khanna Publishers, New Delhi 1969.

2. S.N. Sinha 'Reinforced Concrete Design' Tata McGraw Hill, New Delhi 1998.

3. Ashok K. Jain 'Reinforced Concrete Limit State Design" Nemchand, Bros Roorkeee 1983.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Ability to understand the different concepts of WSM methods using the code provisions
CO2	Ability to understand the different concepts of LSD methods using the code provisions
CO3	Ability to design RCC beams and slabs by applying the aboveconcepts.
CO4	Ability to design RCC slabs by applying the aboveconcepts.
CO5	Ability to design RCC dog legged staircase design usingLSD.
C06	Ability to design RCC foundation.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M				H	H		H
	CO2			M		H					L		
	CO3					L				M			
	CO4					L				M		M	
	CO5	H		M	M				M		H	W	H
	C06						H	H					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 5E1	ELECTIVE I- ENERGY EFFICIENT ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To inform the need to use alternative sources of energy in view of the depleting resources and climate change.
- To familiarise the students with simple and passive design considerations
- To inform about the importance of day lighting and natural ventilation in building design
- To make the students aware of the future trends in creating sustainable built environment.

UNIT I **9**

PASSIVE DESIGN

Significance of Energy Efficiency in the contemporary context, Simple passive design considerations involving Site Conditions, Building Orientation, Plan form and Building Envelope - Heat transfer and Thermal Performance of Walls and Roofs

UNIT II **8**

ADVANCED PASSIVE ARCHITECTURE- PASSIVE HEATING

Direct Gain Thermal Storage ofWall and Roof - Roof Radiation Trap - Solarium - Isolated Gain

UNIT III **10**

PASSIVE COOLING 8

Evaporative Cooling - Nocturnal Radiation cooling - Passive Desiccant Cooling - Induced Ventilation - Earth Sheltering - Wind Tower - Earth Air Tunnels

UNIT IV **6**

DAY LIGHTING AND NATURAL VENTILATION

Daylight Factor - Daylight Analysis - Daylight and Shading Devices - Types of Ventilation - Ventilation and Building Design.

UNIT V **12**

CONTEMPORARY AND FUTURE TRENDS 12

Areas for innovation in improving energy efficiency such as Photo Voltaic Cells, Battery Technology, Thermal Energy Storage, Recycled and Reusable Building materials, Nanotechnology, smart materials and the future of built environment, Energy Conservation Building code.

TOTAL: 45 PERIODS

OUTCOMES:

- The students are exposed to alternative sources of energy and are exposed to passive design considerations
- An understanding on day lighting and natural ventilation in design in addition to the future trends in creating sustainable built environment

TEXTBOOK:

1. Manual on Solar Passive Architecture, IIT Mumbai and Mines New Delhi - 1999
2. Arvind Krishnan & Others, Climate Responsive Architecture, A Design Handbook for Energy Efficient Buildings, TATA McGraw Hill Publishing Company Limited, New Delhi, 2001
3. Majumdar M, Energy Efficient Building in India, TERI, 2000.

REFERENCES:

1. Fuller Moore, Environmental Control Systems, McGraw Hill INC, New Delhi - 1993
2. Sophia and Stefan Behling, Solpower, the Evolution of Solar Architecture, Prestel, New York, 1996
3. Givoni .B, Passive and Low Energy Cooling of Buildings, Van Nostrand Reinhold, New York, 1994
4. The energy efficient home: a complete guide by PatrickWaterfield, Crowood press ltd.
5. Dean Hawkes, Energy Efficient Buildings:Architecture, Engineering and Environment, W.W. Norton & Company
6. David Johnson, Scott Gibson, Green from the Ground Up: Sustainable, Healthy and Energy efficient home construction, Published April 2008 by Tauton.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Demonstrate*** the concept of passive design in built environment
CO2	Ability to critically understand and address issue of resources.
CO3	***Analyze*** the impact of spatial configuration at building level and at site level on passive design.
CO4	***Analyze*** and interpret different case buildings.
CO5	***Design*** and development energy efficient buildings.
C06	***Develop*** working drawings and model displaying energy efficient and green building technologies.

Mapping of Course Outcomes with Program Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M			M	H	H		H
	CO2			M	M						L		
	CO3									M			H
	CO4		L			L	H			M		M	
	CO5		M	M	M						H		H
	C06	H				M		L					
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	25th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 5E1	ELECTIVE I- THEORY OF DESIGN	3	0	0	3

OBJECTIVES:

- To understand design and the role of the designer in changing society.
- To familiarize the students with methodologies, theories and models of the design process.
- To inform students about the term creativity and introduce techniques which will enable creative thinking.
- To inform the approaches that generate ideas for architectural design and the importance of the participatory approach to design.

UNIT I **9**

INTRODUCTION TO DESIGN

Definition and understanding of design- design in history -changing role of designer on society different classifications of design according to scale, process, mode of production, etc.,

UNIT II **8**

DESIGN METHODOLOGY MOVEMENT

Context for the rise of the design methodology movement- theories of the first generation and the second generation design methodologists- various models of the design process- focus on the design problem: ideas of escalation/regression and wicked problem.

UNIT III **10**

CREATIVE THINKING

Understanding the term creativity- theories on thinking: left brain/ right brain, convergent and divergent thinking, lateral and vertical thinking- design spectrum from the logical to chance - blocks in creative thinking- various techniques to generate creativity

UNIT IV **12**

ARCHITECTURAL CREATIVITY

Design puzzles and traps - approaches to generate ideas for architectural design - types of concepts- personal philosophies and strategies of individual designers - channels to creativity in architecture

UNIT V **6**

DESIGN AND PEOPLE

Concept of pattern language- participatory approach to design - design as process

TOTAL: 45 PERIODS

OUTCOMES:

An ability to think about architecture as one of the many fields under the broader ambit of design as a fundamental human activity.

TEXTBOOK:

1. Geoffrey Broadbent - Design in Architecture - Architecture and the human sciences - John Wiley & Sons, New York, 1981.

2. Bryan Lawson - How Designers Think, Architectural Press Ltd., London, 1980.

3. Anthony Antoniades, Poetics of architecture- Theory of design

4. Paul Alan Johnson, Theory of Architecture- Concepts, Themes,Wiley 2008 VNR, 1994

5. Christopher Alexander, Pattern Language, Oxford University Press,1977

6. James C. Snyder, Anthony J. Catanese, Timothy L. McGinty- Introduction to Architecture, McGraw Hill 1979.

REFERENCES:

1. Victor Papanek, Design for the real world

2. Edward De Bono, Lateral Thinking, Penguin, 1990.

3. Design methods- Christopher Jones, Wiley, 1980.

4. Tom Heath - Method in Architecture, John Wiley & Sons, New York, 1984.

5. Nigel Cross - Developments in Design Methodology, John Wiley & Sons, 1984.

6. Evans, Helen Marie; Dumesnil, Carla Davis- An Invitation to Design, Macmillan Publishing Co., New York, 1982

COURSE OUTCOMES (COs)	
The student will be able	
CO1	An ability to think about architecture as one of the many fields under the broader ambit of design as a fundamental human activity.
CO2	Focuses on the aesthetic and **function** of the structure.
CO3	It's **design** works to create a space that flows with its surroundings.
CO4	The infinite variety of these spaces can be as varied as life itself
CO5	**design theory** is a system of ideas that explains how and why **design** works.
CO6	To know how everything they put on a page communicates, influences, directs, invites, entices and excites an audience

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	a	b	c	d	e	f	g	h	i	j	k	l
	CO2	H					M			M			
	CO3		L			L					H		
	CO4	M		M				L					
	CO5		L				M						M
3	Category	PE											
4	Approval	27THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 5L2	COMPUTER STUDIO II	0	0	4	3

OBJECTIVES:

- To introduce Computer operation principles and explore image editing through a visual composition using graphics.
- To impart training in Computer aided 2D drafting and 3D Modeling through projects
- To enable the rendering of a building so as to create a photo realistic image.

UNIT I **10**

INTRODUCTION TO COMPUTER AND IMAGE EDITING

Technology of small computer system, computer terminology operation principles of P.C., introduction to application software, and graphic system, and use of printers, scanner, plotter, File management, etc. Understanding Bitmap images and Vector Graphics, Image size and Resolution. Basic Tools for Editing and Creating Graphics.

UNIT II **15**

THE BASICS OF BUILDING MODELLING

Creating a basic floor plan, About Temporary Dimensions, Adding and Modifying Walls, Working with Compound Walls, Using Editing Tools, Adding and Modifying Doors, Adding and Modifying Windows

UNIT III **20**

VIEWING THE BUILDING MODEL

Understanding the drawing unit's settings, scales, limits, drawing tools, drawing objects, object editing, and text, dimensioning. Transparent overlays, hatching utilities, line type, line weight and colour. Multiline, Polyline, etc. Styles, blocks and symbol library.

UNIT IV **15**

INTRODUCTION TO 3D MODELLING

Project: Create 3D sculpture using 3D primitives (cubes, spheres etc.)

Tools: Slide facilities script attributes, V-port, editing session. Introduction to 3D-modelling technique and construction planes, drawing objects, 3D surfaces setting up elevation thickness and use of dynamic projections.Solidmodelingwith primitive command andBoolean operation.

UNIT V **15**

3D RENDERING AND SETTING

Project: Visualize a building. Explore the potential of lights and camera and use the same in the model created for the final submission. Tools: Rendering and scene setting to create a photo realistic picture,

understanding material mapping, environment setting and image filling. Exercise to identify and visualize a building using the above said utilities.

TOTAL: 75 PERIODS

OUTCOMES:

- The students benefit by learning software which helps them to better visualize complicated forms and also helps in producing photo realistic images of those 3D forms.

TEXTBOOK:

1. Photoshop 7Bible ProfessionalEdition,Wiley John&Son INC,NewYork,Deke McClelland, 2000.

2. AutoCAD architectural user guide – Autodesk Inc., 1998.

3. A. Watt, Fundamentals of Three-Dimensional Computer Graphics, Addis Wesley, Massachusetts, 1989.

REFERENCES:

1. The Illustrated AutoCAD 2002 Quick Reference, Ralph Grabowski,

2. Autocad 2000: A Problem-Solving Approach, Sham tikoo. Pub: Thomson Learning, 1999.

3. 3D MAX - 6 Bible, Wiley, 2004.

CO1	To ***apply*** softwares in the field of Architecture to represent design ideas.
CO2	***Produce*** 2D technical drawings using AutoCAD
CO3	***Develop*** the 3D model of buildings & objects using AutoCAD and Sketch Up
CO4	***Recreate*** realistic image of objects and buildings by using presentation software.
CO5	Sheet set ***organization*** and plot/print drawing to the scale. In photoshop
C06	Ability to develop knowledge.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	H	M			M	H	H		H
	CO2			M	M	H					L	H	L
	CO3					L		M					
	CO4	H	L			L		M					
	CO5	H	M	M	M				M		H		H
	C06					L							
3	Category	ProfessinalAbilityEnhancement Courses (PAEC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
BAR 504	MATERIALS AND CONSTRUCTION – IV	2	0	4	4

UNIT I

FERROUS METALS **5**

Brief study on manufacture,properties and uses of cast iron,wrought iron,pig iron and steel - anticorrosive measures for steel - mechanical and heat treatment of steel - market forms of steel - structural steel, stainless steel, steel alloys - properties and uses - current developments.

UNIT II

STEEL CONSTRUCTION **10**

Structural steel sections - types of connections in steel - steel in foundations, columns and beams - different types of steel roof trusses including northlight truss - space frames - materials for roofcovering. Steel staircases and handrails,balusters. Steel doors and windows - openable, sliding - collapsible gates - rolling shutters. Steel in furniture and other interior uses. Detailing and specification for physically handicapped.

UNIT III

NON FERROUS METALS **15**

Aluminium and Aluminium Alloys - brief study on manufacture,properties and uses - Aluminium products - extrusions,foils,castings,sheets,etc.-tin and lead,properties and uses - current developments.

UNIT III

CONSTRUCTION USING NON-FERROUS METALS **20**

Aluminium doors - openable, sliding, pivoted.

Aluminium windows -

openable,sliding,fixed,pivoted.

Aluminium ventilators - top hung,bottom

hung,pivoted,louvred,fixed. Aluminium partitions,false

ceiling,shopfront handrails,curtainwalling. Aluminium roofing -

northlight glazing bar ,Aluminium roofing sheets.

Use of other nonferrous metals like copper,bronze,brass,etc.,in architectural construction. Detailing and specification for physically handicapped.

UNIT III

PLASTICS 10

Thermoplastics and thermosets - properties and architectural uses of plastics - structural plastics - reinforced plastics and decorative laminates - plastic coatings,adhesives and seatants - modifiers and plasticzers - fillers and stablizers - fabrications of plastics. Primary plastic building products for walls,roof and partitions -

secondary building products for rooms,windows,roof lights, domes,gullers handrails.

TOTAL:60 PERIODS

TEXTBOOKS:

1. .C.Rangwala,Engineering Materials, Charotar Publishing House,India,1997.
2. B.C.Punmia,Building Construction,laxmi Publications Pvt.Ltd.,New Delhi,1993.
3. Arthur Lyons - Materials for Architects and Builders - An Introduction - Arnold,London,1997.
4. Don A.Watson,Construction Materials and processes,McGraw Hill Co.,1972.
5. Harold B.Olin,Construction Principles materials and Method, The Institute of Financial Education, Chicago,1980.
6. Time Saver Standards for Architectural Design Data,Callendar JH,McGraw Hill,1974.

WEBSITES

http://www.britmetfed.org.uk/medu.html

http://www.indiabussinesSonline.com

http://www.nrwas.com

http://www.arcadiaproducts.com

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Identify*** the appropriate Ferrous and Non-Ferrous materials in construction.
CO2	***Identify*** appropriate construction techniques using Ferrous and Non-Ferrous materials in construction
CO3	***Assess*** the suitable steel roof truss for different spans of industrial buildings.
CO 4	***Detailed drawings of Ferrous and Non Ferrous, Glass based building components***
CO5	***Apply the property of glass towards "Energy conservation***
C06	***Knowledge of properties of ferrous and non-ferrous metals as materials for buildings***

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	H				M		H		H
	CO2	L	H		M						L	H	L
	CO3	H				L				M			
	CO4	M	L							M			
	CO5		M	M					M		H		M
	C06					H	M						
3	Category	Building Sciences and Applied Engineering (BS &AE)											
4	Approval	32nd Meeting of Academic Council											

SEMESTER VII

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR701	COST ESTIMATION AND BUDGETTING	3	0	0	3

OBJECTIVES

- To enable understanding with respect to quality and quantity of materials, quantity and classes of skilled and unskilled labours, and tools and plants required for projects.
- To give an understanding of how to draw up specifications for the different items of a building project and also to prepare the schedule of programming of the project.
- To give knowledge on how to prepare approximate as well as detailed estimates and to have a clear picture of the project expenditure.
- To help calculate the exact quantities of items of work done for effecting payment especially when direct measurements are difficult and also to determine the quantities of different materials required for various items of work.
- To give understanding of how to prepare valuation report of real and landed property.
- To give exposure to budgeting in projects.

UNIT I
SPECIFICATION AND SPECIFICATION WRITING 9

Necessity of specification, importance of specification.How to write specification.Types of Specification.Principles of Specification writing.Important aspects of the design of specification.Sources of information.Classification of Specification.Brief Specification for1st class, 2nd class, 3rd class building. Detailed specification for earthwork excavation, plain cement concrete, reinforced concrete, first class and second class brickwork, damp proof course, ceramic tiles/marble flooring and dado, woodwork for doors, windows frames and shutters, cement plastering, painting & weathering course in terrace.

UNIT II
ESTIMATION 9

Types & purpose.Approximate estimate of buildings. Bill of quality, factors to be considered. Principles of measurement and billing.Contingencies.Measurement of basic materials like brick, wood, concrete and unit of measurement for various items of work.Abstract of an estimate. Costs associated with constructed facilities. Approaches to cost estimation. Type of construction cost estimates. Cost Indices. Applications of cost indices to estimating. Estimate based on engineer's list of quantities. Estimation of operating costs.

UNIT III
DETAILED ESTIMATE 11

Deriving detailed quantity estimates for various items of work for a single storied building. To include earthwork excavation, brick work, plain cement concrete, reinforced cement concrete works, wood work, iron works, plastering, painting, flooring, weathering course.

UNIT IV
VALUATION **8**

Valuation.Explanation of terms.Types of values.Sinking fund.Years of purchase.Depreciation. Types of depreciation.Valuation of real properties.Types, methods and purpose of valuation.

UNIT V
BUDGETING **8**

Elements of cash flow.Time value of money. Capital investment decision. Types of business firms. Budget and Budgetary Control.Types of Budgets.Preparation of financial budget.

TOTAL: 45 PERIODS

TEXTBOOKS:

Rangwala. S.C, 'Estimating, Costing and Valuation (Professional practice)', Charotar Publishing House,1984
M.Chakraborthi, 'Estimating, Costing, Specification and Valuation in Civil Engineering, Chakraborthi, 2010.
B.N. Dutta, 'Estimating and Costing' UBS Publishers and Distributors,2000.
S.SangaReddi and P.L.Meiyappan, 'Construction Management', Kumaran Publication, Coimbatore.
Gurcharan Singh and Jagdish Singh, 'Estimating Costing and Valuation', Standard Publishers Distributors, 2012.

REFERENCES:

'I.S.1200-1968 Methods of Measurements of Buildings and Civil Engineering works'.
Latest schedule of rates of P.W.D.
Latest Data book of P.W.D.
PWD Standard Specifications. Govt Publication.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the unit measurement of materials.
CO2	***Understand*** the techniques of estimating and costing related to building construction.
CO3	***Apply and understand*** the various methods of quantity surveying, rate analysis of building and valuation for different materials used. Calculate material cost of given component/product.
CO4	***Know*** about Specification for basic building material and apply the same for another example
CO5	***Understand and apply*** the concepts of project planning and basics of financial management
CO6	***Analysing***the cost of the projects

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H							M				
	CO2		L								M		H
	CO3			M			M			L			
	CO4	H			H			L					H
	CO5		M			H			L				
3	Category	PC											
4	Approval	27THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR702	PROJECT MANAGEMENT	3	0	0	3

UNIT I **9**
INTRODUCTION TO PROJECT MANAGEMENT

Introduction to project Management concepts of background of management, purpose, goal and objectives, characteristics of projects and different aspects of management.
Traditional management system, Gantt's approach load chart, progress chart, bar-chart merits and limitation. Schedule, time estimates units.

UNIT II **8**
PROJECTS PROGRAMMING

Project programming, resources balancing, phasing of activities, program, scheduling, project control, reviewing, updating and monitoring.
Introduction to modem management, concepts, uni dimensional management techniques – Introduction to PERT and CPM introduction to network concepts, network elements and inter-relationships.

UNIT III **10**
NETWORK – TECHNIQUES

Network techniques, network logic o inter relationships, activity information, data sheets, development of network.
CPM for management, CPM network analysis, identification of critical path float computation result sheets.

UNIT IV **12**
PERT NETWORK

PERT Network, introduction to the theory of probability and statistics, probabilistic time estimation for activities of PERT network.

UNIT V **6**
PROJECT COST

Introduction to two dimensional network analysis, activity cost information. Cost time relationship, crashed estimates for the activities, compression potential, cost slope, utility, data sheet, project direct cost and indirect cost.
Crashed program, network compression least cost solution least time solution, optimum time solution.
Network techniques, PERT/CPM, generating alternative strategies using computers.

TOTAL: 45 PERIODS

TEXT BOOKS:

Dr. B.C. Punmiya and K.K. Khandelwal – "Project Planning and Control with Pert/CPM" Laxmi Publications. New Delhi, 1987.

REFERENCES:

S.P. Mukhopadyay, "Project Management for Architects and Civil Engineers", IIT, Kharagpur, 1974.
Jerome D. Wiest and Fenfinand K. Levy, "A Management Guide to PERT / CPM".Prentice Hall of Indian Pub.Ltd. New Delhi 1982.
R.A. Burges and G. White, "Building production and Project Management", The Construction Press, London 1979.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Initiate projects with clearly identified scope, requirements, and stakeholders
CO2	Plan complex projects using appropriate **planning** tools
CO3	Develop plans to implement quality and resource management processes.
CO4	Manage project risk.
CO5	Manage project costs including procurement process for project resources.
CO6	Benefits that are observable within the targeted environment

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M				L					L		
	CO2		H				M					L	
	CO3	L			M			H					
	CO4		H			H					M		
	CO5			L			L			M			
3	Category	PAEC											
4	Approval	25THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR703	URBAN DESIGN	3	0	0	3

OBJECTIVES

- To create an understanding of urbanism and urban morphology as rising from various forces through history.
- To introduce the components of the modern city and their interdependencies.
- To introduce the scope and nature of urban design as a discipline
- To introduce key theories associated with urbanism and cities.
- To create awareness of contemporary urban issues and how they are addressed.
- To give exposure to ways of perceiving, documenting and analysing cities.

UNIT I
URBANISM IN HISTORY **10**

Outline of forces shaping urbanism. Urbanism of river valley civilisations.Morphology of pre-industrial European cities to include Greek and Roman cities, medieval European towns, Renaissance urbanism and ideal cities. Outline of historic cities of India. Temple town urbanism of Tamil Nadu.Mughal city form.Medieval cities of India.Colonial urbanism in India.

UNIT II
MODERN URBANISM **10**

Industrialisation and impact on urbanism.American grid iron planning.Theories, ideas and practice of good urban planning/cities/urbanism in early 20th century. Outline of modernist cities and urbanism across the world. Morphology of Indian modernist cities of Chandigarh, Bhuvaneshwar and Gandhi Nagar.Components of modern urbanism such as blocks, density, neighbourhood, streets etc., and their interdependencies.Evolution of urban design as a discipline, its scope and objectives.

UNIT III
CITIES AND URBANISM THROUGH TEXTS AND THEORIES **10**

Introduction to and discussion of key texts and theories of cities and urbanism - Imageability and Lynch, Townscape and Cullen, Genius Loci and Schulz, historic city and Rossi, social aspects of urbanism and the works of Jane Jacobs, William Whyte and Jan Gehl, Collage City and Colin Rowe, current theories and texts.

UNIT IV
CONTEMPORARY URBANISM AND URBAN INTERVENTIONS7

Understanding aspects, issues and solutions related to urbanism today through study of literature and best practices/case studies in urban design. Topics to include urban decay, change and renewal, place making, heritage, conservation, identity, suburban sprawl, gated communities, generic form, privatisation of public realm, role of real estate, transportation, zoning, globalisation, technology, digital age, sustainability, community participation, gender, class, power.

UNIT V
URBAN STUDIES **8**

Introduction to study and interpretation of cities (especially Indian) through understanding published studies/ analysis. The focus will be on components/aspects as well as tools/ methods. Tools and methods to include different types of maps/mapping, drawings, sketches, photo documentations, reading, data collection, analysis. Aspects to include topography, geology, hydrology, micro climate, vegetation, urban density, growth, city limits/boundaries, history, urban architecture, typologies, infrastructure, land parcels, public space, demographics, patterns of usage, land use.

TOTAL: 45 PERIODS

TEXTBOOKS

A.E.J. Morris, 'History of Urban Form before the Industrial Revolution', Prentice Hall, 1996.
Edmund Bacon, 'Design of Cities', Penguin, 1976.
Gordon Cullen, 'The Concise Townscape', The Architectural Press, 1978.
Michelle Provoost et al., 'Dutchtown', NAI Publishers, Rotterdam, 1999.
'Time Saver Standards for Urban Design', Donald Natson, McGraw Hill, 2003.
Kevin Lynch, 'The Image of the City' MIT Press, 1960.
Rithchie. A, 'Sustainable Urban Design: An Environmental Approach', Taylor & Francis, 2000.
Tridib Banerjee, Anastasia Loukaitou-Sideris, Editors, 'Companion to Urban Design', Routledge, 2014.

REFERENCES

Jonathan Barnett, 'An Introduction to Urban Design', Harper Row, 1982.
Lawrence Halprin, 'Cities', Reinhold Publishing Corporation, New York, 1964.
Gosling and Maitland, 'Concepts of Urban Design', St. Martin’s Press, 1984.
Malcolm Moor, 'Urban Design Futures', Routledge, 2006.
Geoffrey Broadbent, 'Emerging Concepts in Urban Space Design', Taylor & Francis, 2003.
AnuradhaMathu, 'Deccan Traverses', Rupa, 2006.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Plan / Undertake a study to identify existing issues related urban design in built environment.
CO2	Identify various factors that are responsible urban conditions.
CO3	Gather, correlate and interpret the data that are required for design proposal at historic cities.
CO4	Develop an urban renewal proposal for a city.
CO5	Develop a design proposal for the urban issues relating to the built environment
CO6	To provide a framework for exploring the meaning and **scope of urban design**

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L						M					
	CO2		H								M		
	CO3			M			M						
	CO4	M						M					H
	CO5		L				L				H		
3	Category	PC											
4	Approval	30THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR7L1	ARCHITECTURAL DESIGN VI	0	0	16	8

OBJECTIVES

- To enable an understanding of architecture as having the capacity to critically interpret and transform status quo in the built environment and society through the act of design.
- To guide in the taking of critical/ philosophical/ ideological positions relating to specific design situations in the current world and to explore architectural morphology as an expression of those positions.

CONTENT:

Architecture as a discipline balances many concerns in the creation of buildings. However, it also represents ideas and production reacting to/ reinforcing/ anticipating/ transforming specific aspects of the existing world towards a more desirable future. This could spring from individual perspectives as well as through concerted efforts which then become movements. Architecture can thus seek to understand, reflect, strengthen, question, change status quo. The process of design can thus offer a possible, intended future.

Projects/ design situations will be given in this regard which address issues/ programmes of current society with a larger impact in terms of scale or importance. Different realms/ aspects of contemporary life can be explored. Some possible projects/ area of inquiry are institutional campuses of significance, mixed use projects involving diverse user groups, culturally and socially important buildings, urban life, technological developments, culture, globalisation, place, meaning, identity, appropriate architecture, etc.,

Suitable processes can be engaged for critical and creative thinking which could include wide and interdisciplinary reading to take critical positions, contemporary processes such as mapping and diagramming, methods related to social, technical or empirical aspects, etc.,

The particular line of thought will be taken through to completion through the processes. It is preferable to have one major project with small exercises under it if required.

TOTAL:240 PERIODS

TEXTBOOKS:

Kate Nesbitt, 'Theorizing a New Agenda for Architecture', Princeton Architectural Press, 1996.
Neil Leach, 'Rethinking Architecture', Routledge, 2000.
Harry Francis Mallgrave and David Goodman, 'An Introduction to Architectural Theory- 1968 to the Present', Wiley Blackwell, 2011.
Stephen A. Kliment, Editor 'Building Type Basics' Series, Wiley.

REFERENCES:

Mitchell WJ, 'Imagining MIT: Designing a campus for the 21st century', MIT Press, 2007.
HimanshuBurte, 'Space For Engagement', Seagull Books, 2008.
Mark Garcia, 'The Diagrams of Architecture', Wiley 2010.
BjarkeIngels, 'Yes is More', Taschen, 2009.
Steven Holl, JuhaniPallasmaa, Alberto Pérez Gómez, 'Questions of perception: Phenomenology of Architecture', William Stout, 2006.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the concept of energy efficient design & green building technologies.
CO2	Understand the impact of spatial configuration at building level and at site level on energy consumption
CO3	Analyze and interpret different case buildings.
CO4	Design and development energy efficient buildings.
CO5	Develop working drawings and model displaying energy efficient and green building technologies.
CO6	Demonstrate an understanding of the design philosophy, or vision of the architectural office and its implementation in the project/s

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						M				L	
	CO2		H			M							
	CO3			L			M				M		
	CO4	H			M								L
	CO5		H				H				L		
3	Category	PC											
4	Approval	32NDMeeting of Academic Council											

SEMESTER VIII

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18HSAR801	PROFESSIONAL ETHICS AND PRACTICE	3	0	0	3

OBJECTIVES

- To give an introduction to the architectural profession and the role of professional bodies and statutory bodies as well as ethics of the profession.
- To give familiarity with basic aspects of running an architectural practice.
- To give exposure to the processes involved in taking up and completing an architectural project.
- To inform about legal aspects and legislations associated with the profession.
- To give exposure to the larger implications of professional practice in the globalised world today.

UNIT I
INTRODUCTION TO ARCHITECTURAL PROFESSION CODE OF CONDUCT AND ETHICS

9

Architectural profession and role of architects in society.Registration of architects.Role of the Indian Institute of Architects. Architects Act 1972- intent, objectives, provisions with regard to architectural practice. Council of Architecture- role and functions.Importance of ethics in professional practice.Code of conduct for architects.Punitive action for professional misconduct of an architect.
Architecture as a professional service towards clients. Architect's office and its management - organisational structure, infrastructure requirement, skills required, elementary accounts, tax liabilities. Setting up architectural practice.

UNIT II
ARCHITECT'S SERVICES, SCALE OF FEES & COMPETITIONS **9**

Mode of engaging an architect.Comprehensive services, partial services and specialised services.Scope of work of an architect.Schedule of services. Scale of fees - Council of Architecture norms. Mode of payment.Terms and conditions of engagement.Letter of appointment.Importance of Architectural competitions.Types of competitions - open, limited, ideas competition, single and two stage competitions.Council of Architecture guidelines for conducting architectural competitions.National and international Competitions.Case studies.

UNIT III
PROJECT MANAGEMENT - TENDER & CONTRACT **12**

Tender - Definition. Types of Tenders - open and closed tenders. Conditions of tender.Tender notice. Tender documents.Concept of EMD.Submission of tender.Tender scrutiny.Tender analysis.

Recommendations. Work order. E-tendering - advantages, procedure, conditions.
Contract – definition. Contract agreement and its necessity. Contents - articles of agreement, terms and conditions, bills of quantities and specifications, appendix. Certification of contractors.Bills at different stages. New trends in project formulation and different types of execution - BOT, DBOT, BOLT, BOO, etc., Role of architect in project execution stage.

UNIT IV
LEGAL ASPECTS **6**

Arbitration - definition and advantages. Sole and joint arbitrators.Role of umpires, award. Arbitration clause in contract agreement -role of architect, excepted matters. Easement – meaning, types of easements. Copy rights and patenting – provisions of copy right acts in India, copy right in architectural profession. Consumer Protection Act - intent, architects responsibility towards his clients.

UNIT V
IMPORTANT LEGISLATIONS AND CURRENT TRENDS **9**

Planning parameters at various scales.DTCP rules. Second Master Plan CMDA as case study. Chennai Corporation Building Rules 1972. Panchayat Rules. Building rules in National Building Code. Factories Act. Persons with Disabilities Act.Barrier Free Environment.Coastal Regulation Zone.Heritage Act.Globalisation and its impact on architectural profession.Preparedness for international practice.Entry of foreign architects in India.Information technology and its impact on architectural practice. Emerging specialisations in the field of architecture -architect as construction/ project manager, architectural journalism, architectural photography.

TOTAL: 45 PERIODS

TEXTBOOKS

Architects Act 1972.
Publications of Council of Architecture
RoshanNamavati, 'Professional Practice', Lakhani Book Depot, Mumbai, 2016.
Ar. V.S. Apte, 'Architectural Practice and Procedure', Mrs.PadmajaBhide, 2008.
MadhavDeobhakta, 'Architectural Practice in India', COA, 2007.

REFERENCES

J.J.Scott, 'Architect’s Practice', Butterworth, London 1985.
Development Regulations of Second Master Plan for Chennai Metropolitan Area-2026. (Second Master plan of CMA).
Chennai City Corporation Building Rules 1972.
T.N.D.M. Buildings rules, 1972.
Consumer Protection Act, 1986.
Arbitration Act, 1996.
Factories Act, 1948.
Persons with Disabilities Act, 1995.
Tamil Nadu Cinematography Act. DTCP Act.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Relate the responsibility of architect towards the society.
CO2	Illustrate the building rules and regulations essentials for practice.
CO3	Know the ethics to be followed while practicing the profession
CO4	Prepare tenders
CO5	Know the office procedure, work with allied professionals as a team in accordance with the architect'sact 1972
CO6	Prepare contract documents

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H							M				
	CO2		L				M						M
	CO3	L		H									
	CO4		M					M			L		
	CO5	M				M							M
3	Category	PAEC											
4	Approval	33RDMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR802	URBAN HOUSING	3	0	0	3

OBJECTIVES

- To introduce housing in the Indian context and the various agencies involved in the production of housing.
- To outline factors, aspects and standards related to housing.
- To inform about the various housing design typologies and the processes involves in housing project development.
- To inform about current issues and aspects in housing.

UNIT I
INTRODUCTION TO HOUSING AND HOUSING ISSUES IN INDIA **9**

Housing and its importance in architecture, its relationship with neighborhood and city planning.Housing demand and supply.National Housing Policy.Housing agencies and their role in housing development.Impact of life style.Rural Housing.Public and private sector housing.

UNIT II
SOCIO-ECONOMIC ASPECTS **9**

Economics of housing.Social economic factors influencing housing affordability.Formal and informal sector.Equity in housing development.Sites and services.Slum housing, upgradation and redevelopment.Low Cost Housing.Health principles in housing.Legislation for housing development.Cost-effective materials and technologies for housing. Case studies in India and developing countries.

UNIT III
HOUSING STANDARDS **8**

UDPFI guide lines, standard and regulations.DCR. Performance standards for housing.

UNIT IV
SITE PLANNING AND HOUSING DESIGN **11**

Site Planning for housing. Selection of site for housing, consideration of physical characteristics of site, location factors, orientation, climate, topography, landscaping. Integration of services and parking.Housing design relating to Indian situations – traditional housing, row housing, cluster housing, apartments, high-rise housing. Case studies in India of the various types.

UNIT V
CURRENT ASPECTS AND ISSUES IN HOUSING **8**

Green building and sustainable practices.Disaster resistance and mitigation.Prefabrication Community participation.

TOTAL: 45 PERIODS

OUTCOME

Knowledge of various issues concerning housing & housing development in Indian & global context covering a cross section of income groups.
Ability to appreciate socio-economic aspects in housing.
An understanding of housing standards, site planning principles, housing concepts and types.
An understanding of key issues in housing today.

TEXTBOOKS:

Christopher Alexander, 'A Pattern Language', Oxford University press, New York 1977.
Leuris S, 'Front to back: A Design Agenda for Urban Housing', Architectural Press, 2006.
S.K.Sharma, 'Mane A New Initiative in Public Housing', Housing & Urban Development Corporation, 1991.

REFERENCES:

1. Richard Kintermann and Robert Small, 'Site Planning for Cluster Housing', Van Nostrand Reinhold Company, London/New York, 1977.

Joseph de Chiara et al, 'Time Saver Standards for Housing and Residential Development', McGraw Hill Co, New York, 1995.
3. Forbes Davidson and Geoff Payne, 'Urban Projects Manual', Liverpool University Press, Liverpool 1983.
HUDCO Publications, 'Housing for Low Income, Sector Model'.
'Sustainable Building Design Manual: Vol 1 and 2',The Energy Research Institute, 2004.

A.K.Lal, 'Handbook of Low Cost Housing', New Age International Private Limited, 1995.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	On the comptetion of iheccLrse ire student must be aware of the significance of housing
CO2	The context of both global and narrana; scenario.
CO3	critical social and economic issues related to housing
CO4	They should familiarize to the various housing schemes
CO5	Housing Finance, Sources of Housing Finance
CO6	Concept of Aided Self Help- Housing the poor through the NGO s

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					L						
	CO2	H						M				M	
	CO3		M				M						L
	CO4	M			L					M			
	CO5			M					M				
3	Category	PC											
4	Approval	31STMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR8L1	ARCHITECTURAL DESIGN VII	0	0	16	8

OBJECTIVES:

- To enable an understanding of urbanism as a continuous experience involving the interrelated disciplines of architecture, urban design and town planning.
- To understand architecture as influenced by and influencing the dynamics of cities.
- To facilitate the taking of architectural design decisions in the context of the urban environment.

CONTENT:

Urbanism is a dynamic phenomenon involving many aspects - urban growth, landuse distribution and change, urban form, demographics including gender and class, cultural aspects such as place and heritage, physical infrastructure such as roads and transportation nodes, public spaces, etc., Architecture is an integral and large part of urbanism, shaping and being shaped by it. It can serve to include/ gather society and enrich the urban environment in a seamless manner.

Understanding of this aspect of architecture will be achieved by architectural projects involving interdependencies between architecture and the city. Some of the issues and areas that could be addressed are- transportation nodes, heritage areas, adaptive reuse, suburban sprawl, place making, identity, collective memory, mixed use programming, large scale urban interventions, revitalisation and renewal of urban fragments, urban waterfront development, urban nodes, multi-use urban complexes.

The tools and techniques can include contemporary ways/ tools of perceiving, gathering and analysing data, inclusive, collaborative and participatory approaches, etc.,
It is preferable to have one major project with small exercises under it if required.

TOTAL: 240 PERIODS

TEXTBOOKS

Jonathan Barnett, 'An Introduction to Urban Design', Harper and Row; 1982
Cavallo, R. et al, 'New Urban Configurations', IOS Press, 2014.
Henriette Steiner & Maximilian Sternberg, 'Phenomenologies of the City: Studies in the History and Philosophy of Architecture', Routledge 2015.
Jan Gehl, 'Life between Buildings- Using Public Space', ArkitektensForleg 1987.
'Time Savers Standard for Urban Design', Donald Watson, McGraw Hill, 2005.
Malcolm Moore & Jon Rowland Eds, 'Urban Design Futures', Routledge, 2006.

REFERENCES

Michelle Provoost et al., 'Dutchtown', NAI Publishers, Rotterdam, 1999.
Lawrence Halprin, 'Cities', Reinhold Publishing Corporation, New York, 1964.
Gosling and Maitland, 'Urban Design', St. Martin's Press, 1984.
Kevin Lynch, 'Site Planning', MIT Press, Cambridge 1967.
Jeremy Till et al, 'Spatial Agency: Other Ways of Doing Architecture', Routledge, 2011.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Demonstrate knowledge of the spatial planning system and basic tools of spatial policy in Poland and the EU.
CO2	Demonstrate knowledge of contemporary ideas of shaping space in cities.
CO3	Identify principles of formulating local zoning plans for advanced urban complexes using the applicable notation.
CO4	Demonstrate broad knowledge which takes into consideration the interdisciplinary character of circumstances of urban planning
CO5	Demonstrate advanced knowledge of parameters of traffic engineering and the principles of designing roads, streets, cycle lanes, pedestrian precincts and parking lots and equipment of technical infrastructure
CO6	Identify the regulations and procedures of formulating local land-use plans. zoning and their impact on the investment.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M		L					M				
	CO2		H				L				M		
	CO3	M			L					M			
	CO4		L			L						M	
	CO5	M					M						L
3	Category	PC											
4	Approval	34THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR8L2	DISSERTATION	0	0	8	6

OBJECTIVES:

- To inculcate the spirit of research in architecture.
- To enable the acquisition of in-depth knowledge in a specific aspect/ issue in the discipline of architecture as well as develop perspectives on the same through reading, study, analysis and thought.
- To facilitate the development of a coherent line of thinking and express it through clear writing.
- To serve as prelude to Thesis.

CONTENT

Design studio emphasises on explaining and understanding architecture primarily through the mode of making. However, architecture as a field itself is driven by explicitly stated or implicitly understood ideas/ points of view of particular society and individuals. Dissertation offers an opportunity to look at architecture, history and design through ideas, texts and intent behind works. It involves process of observation, reflection and abstraction. Students are encouraged to choose any topic of their interest.

Topics may range from analysing the works of an architect, history, typological changes, writing, design process and many more. They could involve research based on primary sources in terms of doing actual field studies and/or secondary sources through reading. The dissertation proposal in about 1500 words stating the topic, issues to be explored and the scope must be submitted for approval. Work on the approved topic should start from the beginning of the semester and would be periodically reviewed. At the end of the semester, a well written report of a minimum 10,000 words should be submitted in the prescribed format, if any, provided by the University. The suggested structure for the report can be - outline/ background of the area of study, statement of objectives or research questions within the area of study, outline of methodology/ way to achieve the objectives or answer the questions of research, core section with necessary content such as documentation, analysis, arguments, etc., final conclusion. The report will be presented in the viva-voce exam and defended.

TOTAL: 90 PERIODS

TEXTBOOKS

Iain Borden and KaaterinaRuedi; 'The Dissertation: An Architecture Student's Handbook', Architectural Press, 2000.

Linda Grant and David Wang, 'Architectural Research Methods', John Wiley Sons, 2001.

REFERENCES

Wayne C Booth, Joseph M Williams, Gregory G. Colomb, 'The Craft of Research', 2nd Edition, University of Chicago Press, 2008.

Ranjith Kumar, 'Research Methodology- A Step by Step Guide for Beginners', Sage Publications, 2005.

John W Creswell, 'Research Design: Qualitative, Quantitative and Mixed Methods Approaches', Sage Publications, 2002.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	*Undertake* the research systematically in a chosen topic.
CO2	Illustrate the various methods available for the collection of information.
CO3	Analyses and interpret the information obtained from the study.
CO4	Organize the collected information graphically
CO5	*Develop* a report of the analyzed information with the logical reasoning and conclusion.
CO6	Builds his his/her capacity to work independently and methodically in a variety of intellectually demanding contexts.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L					M				H		
	CO2		M		M					H			
	CO3	L				M						L	
	CO4		H				H						M
	CO5	L						L			M		
3	Category	PAEC											
4	Approval	26THMeeting of Academic Council											

SEMESTER IX

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCAR9PT	PRACTICAL TRAINING	0	0	0	12

OBJECTIVES:

- To introduce the challenges of architectural practice.
- To enable overall understanding of different stages in real life architectural projects in practice.
- To create involvement in these stages as much as possible within the scope of a specific architectural practice - initiation of project, development of concepts into schematic drawings, approval process, presentations and working drawings, involvement in office discussions and client meetings, integrating structural and service concerns, estimation and tendering processes, site supervision and coordination in the construction process.

CONTENT:

Practical Training will be done in offices/ firms in India, empanelled by the institution, in which the principal architect is registered with the Council of Architecture. The student will attempt to learn as much of aspects outlined in the objectives, either first hand or indirectly.

The progress of practical training will be assessed periodically internally through submission of log books along with work done by the students in terms of drawings, reports, etc., along with the regular progress report from the employers.

The students will be evaluated based on the criteria related to their contribution in the office some of which are given below.

- Understanding and involvement in the process of architectural practice as mentioned in the objectives within the scope of the specific office in which training is undertaken.
- Adherence to time schedule, overall responsibility and professional conduct.
- Ability to carry out the instructions on preparation of schematic drawings, presentation drawings, working drawings and skill in this regard.
- Ability to work as part of a team in an office and contribute to related activities.
- Ability to participate in client meetings and discussions.
- Involvement in supervision at project site.
- Involvement/ initiative/ participation in any other aspects during the course of thetraining.
- At the end of the Practical Training, a portfolio of work done during the period of internship along with certification from the office should be submitted for evaluation through a viva voce examination.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Demonstrate an understanding of the design philosophy, or vision of the architectural office and its implementation in the project/s
CO2	Interpret the architectural design process evolves when structural and service issues are integrated to create the final product.
CO3	Demonstrate the Knowledge on how the Drawings are used at site and an insight into the relationship between the site and drawing.
CO4	Develop a office and run the office successfully
CO5	offices / firms in India empanelled by the Institution in which the principal architect
CO6	progress of practical training shall be assessed internally through submission

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M					L				M		
	CO2		L		M								
	CO3	M								H			L
	CO4		H				M				L		
	CO5	M		L									
3	Category	PAEC											
4	Approval	26THMeeting of Academic Council											

SEMESTER X

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PCARXTH	THESIS	0	0	32	18

OBJECTIVES:

All the architectural design courses offered since semester II culminate in the thesis Project to motivate students to involve in individual research and methodology. This is to train them in handling projects independently.

TOPICS OF STUDY

The main areas of study and research can include advanced architectural design, including contemporary design processes, urban design including urban-infill, environmental design, conservation and heritage precincts, housing etc. However, the specific thrust should be architectural design of built environment. Preparation of presentation drawings, working drawings, detailed drawings and study model are part of the requirements for submission.

METHOD OF SUBMISSION

The Thesis Project shall be submitted in the form of drawings, project report, models, slides, CDs and reports.

TOTAL: 510 PERIODS

TEXTBOOK::

Linda Grant and David Wang, Architectural Research Methods, John Wiley Sons, 2002

REFERENCES:

1. Donald Appleyard, The Conservation of European Cities, M.I.T. Press, Massachusetts, 1979.
2. Michelle Provoost et al., Dutchtown, NAI Publishers, Rotterdam, 1999
3. Richard Kintermann and Robert small site planning for cluster Housing van nastrandreinhold company, Jondon/New York 1977.
4. Miller T.G. Jr., Environmental Sciences, Wadsworth Publishing Co. (TB)
5. Kevin Lynch - Site planning - MIT Press, Cambridge, MA - 1967.
6. Geoffrey And Susan Jellico, The Landscape of Man, Thames And Hudson, 1987.
7. Arvind Krishnan & Others, Climate Responsive Architecture, A Design Handbook for Energy Efficient Buildings, TATA McGraw Hill Publishing Company Limited, New Delhi, 2007

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To use all the skills acquired in the duration of preceding academic courses.
CO2	Methodically self-direct effort by choosing the project of choice, builds capacity to work independently and methodically in a variety of intellectually and professionally demanding contexts.
CO3	Learn to make an original and individual, creative contribution to the academic discipline and/or the professional field in some cases.
CO4	Be able to interpret the urban forms of the past and present.
CO5	Articulate their stance and position as a designer within discourses of urbanism.
CO6	Research and analyse information relevant to developing the proposal

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L				M				M			
	CO2		H				H				M		
	CO3	M			M			L					
	CO4		M						M				M
	CO5	L										M	
3	Category	PC											
4	Approval	28THMeeting of Academic Council											

PROFESSIONAL ELECTIVE I

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR001	VERNACULAR ARCHITECURE	3	0	0	3

OBJECTIVES:

- To introduce the study of vernacular architecture as a process and not a product.
- To provide an overview of the different approaches and concepts to the study of vernacular architecture.
- To study the various vernacular architecture forms in the different regions of the country.
- To look at the impact of colonial rule on the vernacular architecture of India.

UNIT I	INTRODUCTION	7

Definition and classification of vernacular architecture. Vernacular architecture as a process. Methodology for survey and study of vernacular architecture. Overview of cultural and contextual responsiveness of vernacular architecture.

UNIT II	APPROACHES AND CONCEPTS	9

Overview of different approaches and concepts to the study of vernacular architecture. Aesthetic, architectural and anthropological studies in detail.

UNIT III	VERNACULAR ARCHITECTURE OF THE WESTERN AND NORTHERN REGIONS OF INDIA	11

Forms, spatial planning, cultural aspects, symbolism, colour, art, materials of construction and construction technique of the vernacular architecture of the deserts of Kutch and Rajasthan (including havelis of Rajasthan), rural and urban Gujarat (including wooden mansions/ havelis in general and that of the Bohra Muslims) and geographical regions of Kashmir (including house boats).

UNIT IV	VERNACULAR ARCHITECTURE OF SOUTH INDIA	8

Forms, spatial planning, cultural aspects, symbolism, art, colour, materials of construction and construction technique, proportioning systems, religious beliefs and practices in the vernacular architecture of Kerala (including houses of the Nair & Namboothri community, Koothambalam and Padmanabhapuram palace) and Tamil Nadu (including houses and palaces of the Chettinad region, agraharams).

UNIT V	WESTERN INFLUENCES ON VERNACULAR ARCHITECTURE OF INDIA	10

Colonial influences on the traditional Goan house. Evolution of the bungalow from the traditional bangla, Victorian villas. Planning principles and materials and methods of construction of the bungalow. Settlement pattern and house typologies of Pondicherry and Cochin.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	An understanding of Indian vernacular architecture as a process and to also provide an overview of various approaches and concepts towards its study.
CO2	Knowledge of vernacular architectural forms in different regions.
CO3	An understanding of the impact of colonial rule on vernacular architecture in India.
CO4	To understand how the contexts of a region have an impact on **vernacular** architectural forms.
CO5	The impact of context of a region over architectural forms
CO6	Expressions will lead to sensible and context specific and sensitive design solutions.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H				L						M	
	CO2		L				M				H		
	CO3	L			L					M			
	CO4		M				M						
	CO5			L					M				H
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	34THMeeting of Academic Council											

PROFESSIONAL ELECTIVE I

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR002	THEORY OF DESIGN	3	0	0	3

OBJECTIVES:

- To understand design and the role of the designer in changing society.
- To familiarize the students with methodologies, theories and models of the design process.
- To inform students about the term creativity and introduce techniques which will enable creative thinking.
- To inform the approaches that generate ideas for architectural design and the importance of the participatory approach to design.

UNIT I	INTRODUCTION TO DESIGN	9

Definition and understanding of design- design in history -changing role of designer on society different classifications of design according to scale, process, mode of production, etc.,

UNIT II	DESIGN METHODOLOGY MOVEMEN	8

Context for the rise of the design methodology movement- theories of the first generation and the second generation design methodologists- various models of the design process- focus on the design problem: ideas of escalation/regression and wicked problem.

UNIT III	CREATIVE THINKING	10

Understanding the term creativity- theories on thinking: left brain/ right brain, convergent and divergent thinking, lateral and vertical thinking- design spectrum from the logical to chance - blocks in creative thinking- various techniques to generate creativity

UNIT IV	ARCHITECTURAL CREATIVITY	12

Design puzzles and traps - approaches to generate ideas for architectural design - types of concepts- personal philosophies and strategies of individual designers - channels to creativity in architecture

UNIT V	DESIGN AND PEOPLE	6

Colonial influences on the traditional Goan house. Evolution of the bungalow from the traditional bangla, Victorian villas. Planning principles and materials and methods of construction of the bungalow. Settlement pattern and house typologies of Pondicherry and Cochin.

TOTAL: 45 PERIODS

TEXTBOOK:

Geoffrey Broadbent - Design in Architecture - Architecture and the human sciences - John Wiley & Sons, New York, 1981.
Bryan Lawson - How Designers Think, Architectural Press Ltd., London, 1980. Anthony Antoniades, Poetics of architecture- Theory of design
Paul Alan Johnson, Theory of Architecture- Concepts, Themes,Wiley 2008 VNR, 1994 Christopher Alexander, Pattern Language, Oxford University Press,1977
James C. Snyder, Anthony J. Catanese, Timothy L. McGinty- Introduction to Architecture, McGraw Hill 19

COURSE OUTCOMES (COs)	
The student will be able	
CO1	An ability to think about architecture as one of the many fields under the broader ambit of design as a fundamental human activity.
CO2	Focuses on the aesthetic and **function** of the structure.
CO3	It's **design** works to create a space that flows with its surroundings.
CO4	The infinite variety of these spaces can be as varied as life itself
CO5	**Design theory** is a system of ideas that explains how and why **design** works.
CO6	To know how everything they put on a page communicates, influences, directs, invites, entices and excites an audience

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	a	b	c	d	e	f	g	h	i	j	k	l
	CO2	H					M			M			
	CO3		L			L					H		
	CO4	M		M				L					
	CO5		L				M						M
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	27THMeeting of Academic Council											

PROFESSIONAL ELECTIVE II

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR003	SUSTAINABLE ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To make student aware about the concepts, of environment, ecology, role of institutions in the country.
- To provide basic knowledge on Sustainable Technologies involved – tracing the growth of settlements – their response to climate – other technical options.
- To provide an orientation to students from Macro Level to Micro Level Design aspects, and
- To expose to students International and National Level agenda on concepts of conservation of Environment and its implications on sustainable concepts of Architecture and planning

UNIT I	INTRODUCTION	9

Planning Concept – Environment Impact Analysis – Ecological Footprints – Essential ingredients of Sustainable Development apart from Social and Economical – Environment, Stakeholders Participation, and Institutional Mechanism.

UNIT II	DEVELOPMENT IN HISTORICAL CONTEXT	8

Early settlement pattern – Climate Responsive Planned Layouts – orientation of Streets and Buildings, Creation of Habitable Environment, Early Planning Methods – Land Generation, Soil and Water Conservation, Bioregional Approach.

UNIT III	RESOURCE EFFICIENCY	10

Land, Water, Energy, Human Resource, Biodiversity – Suitable practices at settlement, Campus and Building Level

UNIT IV	SUSTAINABLE ARCHITECTURE	12

Appropriate materials and construction – review of their properties workability, Eco Friendly construction practices – Need for Legislation – sustainable campuses, neighborhoods, programs and case studies.

UNIT V	SUSTAINABLE PLANNING AND POLICIES	6

Awareness program at National, International levels Rio de Jenero agenda – Earth summits – agenda involved – their realization.

TOTAL: 45 PERIODS

TEXTBOOK:

Manik & Girish Komisva, IIPA,
Keeping Cities Clean and Green, Uppal Publishing House, 1997. Beer,
Environment Planning for Site Development.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	The students are oriented about the concepts of ecosystem carrying capacity, Understanding the footprint sustainability and sustainable development.
CO2	The students ate aware of the emerging vulnerabilities of global warming and climate change and understand the contribution of building industry to the same
CO3	The students are familiar with the various approaches to achieving sustainable buildings and communities
CO4	The students understand the various incentives and evaluation systems for green buildings.
CO5	Concept of Green buildings-Green building design
CO6	To understand the concept of sustainability and sustainable development

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		L			L							M
	CO2	M					H			L			
	CO3		L			M					L		
	CO4	M		L				M					
	CO5		M				L						M
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	25THMeeting of Academic Council											

PROFESSIONAL ELECTIVE II

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR004	GLASS ARCHITECTURE AND DESIGN	3	0	0	3

OBJECTIVES:

- To introduce latest advances in the field of glass in architecture.
- To enable right selection and usage of right glass for appropriate purposes.
- To give understanding of use of glass in contemporary architecture as well as its role in green design and improving building performance

UNIT I	INTRODUCTION	10

Evolution & importance of glass in modern architecture. Applications of glass in buildings (façade/ interior applications). Understanding the production & properties of glass. Value additions including coating technology (importance & necessity) and processing (tempering, heat strengthening, DGU, laminated, ceramic fritting). Types of Glass- mirror, lacquered, fire resistant. Modern glass with different applications. Glass for hospitals, green homes, airports, offices, other buildings. Glass and human safety compliances. Role of glass in fire safety considerations - Class E, EI & EW. Role of glass in acoustics. International standards & codal provisions.

UNIT II	DEVELOPMENT IN HISTORICAL CONTEXT	10

Building Physics. Theory of electromagnetic radiation. Understanding of internal and external reflections. Day-lighting in Buildings - introduction and basic concepts (VLT) . Solar Control and thermal insulation (SF, UV, SHGC). Need for green Buildings. Energy efficient buildings. Achieving energy efficiency using glass. Factors of energy efficient material selection. Performance parameters. Energy codes and Green ratings - ECBC, IGBC, GRIHA. Approaches of energy efficiency - prescriptive method, trade off method. Accommodating passive architecture. Whole Building Simulation.

UNIT III	RESOURCE EFFICIENCY	10

Case study of green building designed predominantly with energy efficient materials. Calculations involving basic factors in glass design. Optimization of Glass - for wastage reduction and standardisation of Design. Construction site/ green building visit report**.**

UNIT IV	SUSTAINABLE ARCHITECTURE	15

Appropriate materials and construction – review of their properties workability, Eco Friendly construction practices – Need for Legislation – sustainable campuses, neighborhoods, programs and case studies.

UNIT V	SUSTAINABLE PLANNING AND POLICIES	15

Analysis of thickness for safety, consideration of aesthetics, economy, optimisation and wastage, air-conditioning load calculations and payback analysis.

TOTAL: 45 PERIODS

TEXTBOOK:

Christian Schittich, 'Glass Construction Manual', Birkhauser Basel, 2007. 'Architectural Glass Guide', Federation of Safety Glass, 2013.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Latest advances in the field of glass in architecture.
CO2	Enable right selection and usage of right glass for appropriate purposes.
CO3	To give understanding of use of glass in contemporary architecture as well as its role in green design and improving building performance
CO4	An understanding of glass and its potential in contemporary usage
CO5	An understanding of tools and software currently in practice with respect to the use of glass in buildings
CO6	Analysis of thickness for safety, consideration of aesthetics, economy

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	a	b	c	d	e	f	g	h	i	j	k	l
	CO2	M					L			L			
	CO3		M			M					H		
	CO4	H		L				L					
	CO5		L				M						H
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	27THMeeting of Academic Council											

PROFESSIONAL ELECTIVE III

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR005	INTERIOR DESIGN	3	0	0	3

OBJECTIVES:

- To provide familiarity with the characteristics of interior spaces and furniture across history.
- To introduce the profession of interior design and bring out its role.
- To inform about the various components of interior space and give an understanding of the design aspects involved in each.

UNIT I	INTERIOR SPACES AND FURNITURE ACROSS HISTORY	11

Outline of the characteristics of representative/ exemplary interior spaces, interior decoration and furniture in the Western world from the beginnings to twentieth century. Outline of characteristics of representative/ exemplary interior spaces, interior decoration and furniture in India across the ages, including living folk traditions.

UNIT II	INTRODUCTION TO INTERIOR DESIGN	7

Introduction to the professions of interior decoration, interior design and furniture design, bringing out their origin, evolution and current scope of work. Definition and process of interior design. Introduction to the design of interior spaces as related to typology, function and themes. Vocabulary of design in terms of elements (point, line, shape, form, space, colour, light, pattern, texture) and principles (balance, proportion, scale, rhythm, hierarchy, unity, contrast, harmony, emphasis, movement) with specific reference to examples from interior design

UNIT III	COMPONENTS OF INTERIOR SPACE - I	9

Role of interior treatment and finishes in the experience of interior spaces. Outline of the design of components such as floors, ceilings, walls, partitions, window treatments and accessories based on parameters such as context, function, ambience, materials, properties, methods of construction, colour, texture. Study of representative examples.

UNIT IV	COMPONENTS OF INTERIOR SPACE - II	9

Role of lighting in the experience of interior spaces. Outline of different types of interior lighting systems and fixtures based on their effects and suitability in different contexts. Study of representative examples.Role of landscaping in the experience of interior space. Outline of interior landscaping elements such as rocks, plants, water, flowers, fountains, paving, artefacts. Their physical properties and effects on spaces. Study of representative examples.

UNIT V	COMPONENTS OF INTERIOR SPACE - III	15

Introduction to furniture design as related to parameters such as human comfort and function (including anthropometrics and ergonomics), built in or freestanding, materials and methods of construction, cultural particularities, changing trends and lifestyles, innovations and design ideas. Study of representative examples.

TOTAL: 45 PERIODS

TEXTBOOK:

- Francis D.K.Ching, 'Interior Design Illustrated', John Wiley & Sons, 2012.
- Joseph DeChiara, Julius Panero, Martin Zelnik, 'Time Saver's Standards for Interior Design', McGraw-Hill Professional, 2001.
- John F. Pile, 'Interior Design', Pearson Prentice Hall, 2007.
- Jan Pieper, George Michell, 'The Impulse to Adorn- Studies in Traditional Indian Architecture', Marg Publications, 1982.
- Aronson J, 'The Encyclopaedia of Furniture', Potter Style, 1965.
- Pat Kirkham, Susan Weber, Editors, 'History of Design: Decorative Arts and Material Culture, 1400-2000', Yale University Press, 2013.

John F.Pile, Judith Gura, 'A History of Interior Design', Wiley, 2013

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To become aware of the planning principle for **designing** various **interior** spaces.
CO2	To gain better understanding as regard the History of furniture, Anthropometric data in space **designing** for various activities.
CO3	To apply Ergonomics in **interior designing**.
CO4	Create a full set of design documents for an interior design project
CO5	Compose written justification of project designs and verbally communicate design
CO6	Collaboration, creating a positive impact on the classroom

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H				L						M	
	CO2		L				M				H		
	CO3	L			L					M			
	CO4		M				M						
	CO5			L					M				H
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	Meeting of Academic Council											

PROFESSIONAL ELECTIVE III

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR006	EARTHQUAKE RESISTANT ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To enable an understanding of the fundamentals of earthquake and the basic terminologies.
- To give basic knowledge of earthquake resistant design concepts.
- To provide familiarity with design codes and building configuration
- To enable understanding of the different types of construction details to be adopted in a seismic prone area.
- To give knowledge for applying earthquake resistant principles in an architectural design project.

UNIT I	FUNDAMENTALS OF EARTHQUAKES	7

Earth's structure, seismic waves, plate tectonics theory, origin of continents, seismic zones in India. Predictability, intensity and measurement of earthquake. Basic terms- fault line, focus, epicentre, focal depth etc.

UNIT II	SITE PLANNING, PERFORMANCE OF GROUND AND BUILDINGS	10

Historical experience, site selection and development. Earthquake effects on ground, soil rupture, liquefaction, landslides. Behaviour of different types of building structures, equipments, lifelines, collapse patterns. Behaviour of non-structural elements like services, fixtures in earthquake-prone zones

UNIT III	SEISMIC DESIGN CODES AND BUILDING CONFIGURATION	10

Seismic design code provisions. Introduction to Indian codes. Building configuration - scale of building, size, horizontal and vertical plane, building proportions, symmetry of building - torsion, re-entrant corners, irregularities in buildings like short storeys, short columns, etc.

UNIT IV	DIFFERENT TYPES OF CONSTRUCTION DETAILS	11

Seismic design and detailing of masonry structures, wood structures, earthen structures. Seismic design and detailing of RC and steel buildings. Design of non-structural elements - architectural elements, water supply, drainage, electrical and mechanical components.

UNIT V	URBAN PLANNING AND ARCHITECTURAL DESIGN	7

Vulnerability of existing buildings, facilities planning, fires after earthquake, socio-economic impact after earthquakes. Conceptual design for earthquake resistance involving institutional masonry building with horizontal spread and height restriction, multi-storeyed RC framed apartment/commercial building.

TOTAL: 45 PERIODS

REQUIRED READING

'Guidelines for earthquake resistant non-engineered construction', National Information centre of earthquake engineering (NICEE, IIT Kanpur, India), 2004.

C.V.R Murthy, Andrew Charlson, 'Earthquake Design Concepts', NICEE, IIT Kanpur, 2006.

Agarwal.P, 'Earthquake Resistant Design', Prentice Hall of India, 2006.

REFERENCES

Ian Davis, 'Safe Shelter within Unsafe Cities: Disaster Vulnerability and Rapid Urbanization' Open House International, UK, 1987

'Socio-economic developmental record'- Vol.12, No.1, 2005.

Mary C. Comerio, Luigia Binda, 'Learning from Practice- A Review of Architectural Design and Construction Experience after Recent Earthquakes', Joint USA-Italy workshop, Oct.18-23, 1992, Orvieto, Italy.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Introduction to Disaster and disaster management
CO2	Basic knowledge of dynamics and methods of dynamic analysis
CO3	Blast and fire resistant design of structures
CO4	Earthquake resistant design of structures
CO5	Design of shear wall
CO6	Retrofitting, rehabilitation and strengthening of structures

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M			M			
	CO2		L			L					H		
	CO3	M		M				L					
	CO4		L				M						M
	CO5	H			M						L		
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	29THMeeting of Academic Council											

PROFESSIONAL ELECTIVE IV

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR007	LANDSCAPE AND ECOLOGY	3	0	0	3

UNIT I	INTRODUCTION	9

Introduction to ecology, landscape conservation, reclamation and landscaping of derelict areas.

UNIT II	PLANT MATERIALS	8

Notes on basic plant data for plant selection and planting design

UNIT III	GARDEN DESIGN	10

A brief description of Mughal gardens of India, Japanese gardens and Italian gardens. Basic principles of landscape design and the visual aspects of plant forms

UNIT IV	SITE PLANNING	12

Site investigation appraisal and site planning neighbourhood parts, Children's parks toilets and sports area.

UNIT V	URBAN PLANNING AND ARCHITECTURAL DESIGN	6

Landscaping for various types of housing areas. Landscaping design for waterfront areas and functional areas in urban centers. Principles of urban landscape, urban design and architectural control.

TOTAL: 45 PERIODS

REFERENCES:

1. Garrett Eckobo. "The Art of Home landscaping", McGraw Hill Book Co., London, 1956.
2. Sylvia Crow Sheila Haywood, "The Gardens of Mughal India", Vikas Publishing House Pvt. Ltd., India, Delhi India, 1973.
3. Testsuro Yoshida, "Gardens of Japan", Jr. Marcus G. Sims, 1963.
4. "Clift Tandy hand Book of Urban Landscape", The Architectural Press, London, 1871.
5. Harvey M. Rubenstain, "A guide to Site and Environmental Planning" 3rd Volume John Wiley and Sons, New York, 1987.
6. John O. Sinurds – "Earthscape", McQraw Hill BOOK Co., New York 1878.
7. T.K Bose & Chowdhary , Tropical garden plants in colour, Allied publishers, Calcutta
8. Bring.M Japanese Gardens, Design & Meaning
9. Introduction to landscape Design,Motloch J L Van Nostrand Rienhold Company

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To obtain knowledge of basic concepts, methods, and applications in **landscape ecology**,
CO2	To examine and understand the ways in which spatial patterns
CO3	Patial processes operate in an **ecological** context
CO4	To learn and become familiar with the techniques used by landscape ecologists in their work
CO5	To understand the relevance of landscape ecology to human society
CO6	To apply the concepts, models, and techniques in landscape ecology in natural resources management.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M				M		
	CO2		L					M					
	CO3	M		M						M			
	CO4		L		M				L				
	CO5	M					M						H
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	34THMeeting of Academic Council											

PROFESSIONAL ELECTIVE IV

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR008	CONTEMPORARY PROCESS IN ARCHITECTURAL DESIGN	3	0	0	3

OBJECTIVES:

- To introduce theories of media and its influence on the perception of space.
- To enable study of the various aspects of digital architecture and its exploration through emerging phenomena that relies on abstraction of ideas.
- To give understanding of the works of contemporary architects who have illustrated the influence of the digital media in architecture.

UNIT I	INTRODUCTION	7

Investigation of contemporary theories of media and their influence on the perception of space and architecture. Technology and art. Technology and architecture. Digital technology and architecture.

.

UNIT II	ASPECT OF DIGITAL ARCHITECTURE	8

Aspects of digital architecture. Design and computation. Difference between digital process and non-digital process. Architecture and cyberspace. Qualities of the new space. Issues of aesthetics and authorship of design. Increased Automatism and its influence.

UNIT III	CONTEMPORARY PROCESS	10

Emerging phenomena such as increasing formal and functional abstractions. Diagrams, diagrammatic reasoning, diagrams and design process. Animation and design. Digital hybrid.

UNIT IV	GEOMETRIES AND SURFACES	9

Fractal geometry. Shape grammar. Hyper surface. Liquid architecture. Responsive architecture.

UNIT V	CONTEMPORARY PROCESS AND ARCHITECTURAL WORKS	11

Ideas and works of architects related to contemporary processes. The architects to include Greg Lynn, Reiser + Umemotto, Lars Spuybroek / NOX Architects, UN studio, Diller Scofidio, Dominique Perrault, Decoi, Marcos Novak, Foreign Office Architects, Asymptote, Herzog and de Meuron, Neil Denari, Serie Architects, BIG Architects. Study to be undertaken in the form of assignments/discussions/seminars/presentations.

TOTAL: 45 PERIODS

TEXTBOOKS:

Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', in Illuminations, Schocken Books, New York, 1969
Ignaci de Sola Morales,'Differences: Topographies of Contemporary Architecture', MIT Press,1997.
William J Mitchell, 'The Logic of Architecture: Design, Computation and Cognition', MIT Press, 1995.
Ali Rahim, 'Contemporary Process in Architecture', John Wiley & Sons, 2000.
Ali Rahim (Ed), 'Contemporary Techniques in Architecture', Halsted Press, 2002.

Peter Eisenmann; Diagram Diaries, Universe,1999.
Grey Lynn, 'The Folded, The Pliant and The Supple, Animate form', Princeton Arch. Press,1999.

REFERENCES:

Gillian Hunt, 'Architecture in the Cyberspace II', John Wiley & Sons, 2001.
L. Convey et al, 'Virtual Architecture', Batsford, 1995.
Rob Shields (ed.), 'Cultures of the internet: Virtual Spaces, Real Histories, Living bodies', Sage, London, 1996.
John Beckman, 'The Virtual Dimension, Architecture, Representation and Crash Culture', Princeton Architecture Press, 1998.
William J Mitchell, City of Bits: Space, Place and the Infobahn',MIT Press, Cambridge, 1995.
Marcos Novak, 'Invisible Architecture: An Installation for the Greek Pavilion', Venice Biennale, 2000.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the impact of literature in architecture on philosophical development of design.
CO2	***Understand*** the alternative architectural methods available.
CO3	***Exposed*** to the master architects works and trace the development of evolution of their style.
CO4	Understand the spatial organization and spatial qualities of different typologies of buildings.
CO5	Knowledge of the contemporary design process and apply the same in the architectural design.
CO6	To gain knowledge of the spatial organization and articulation in the works of master architects.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H					M
	CO2		H				M				H		
	CO3	M			M				M				
	CO4		H			H						M	
	CO5	M		M							L		
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	30THMeeting of Academic Council											

PROFESSIONAL ELECTIVE IV

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR008	CONTEMPORARY PROCESS IN ARCHITECTURAL DESIGN	3	0	0	3

OBJECTIVES:

- To introduce theories of media and its influence on the perception of space.
- To enable study of the various aspects of digital architecture and its exploration through emerging phenomena that relies on abstraction of ideas.
- To give understanding of the works of contemporary architects who have illustrated the influence of the digital media in architecture.

UNIT I	INTRODUCTION	7

Investigation of contemporary theories of media and their influence on the perception of space and architecture. Technology and art. Technology and architecture. Digital technology and architecture.

.

UNIT II	ASPECT OF DIGITAL ARCHITECTURE	8

Aspects of digital architecture. Design and computation. Difference between digital process and non-digital process. Architecture and cyberspace. Qualities of the new space. Issues of aesthetics and authorship of design. Increased Automatism and its influence.

UNIT III	CONTEMPORARY PROCESS	10

Emerging phenomena such as increasing formal and functional abstractions. Diagrams, diagrammatic reasoning, diagrams and design process. Animation and design. Digital hybrid.

UNIT IV	GEOMETRIES AND SURFACES	9

Fractal geometry. Shape grammar. Hyper surface. Liquid architecture. Responsive architecture.

UNIT V	CONTEMPORARY PROCESS AND ARCHITECTURAL WORKS	11

Ideas and works of architects related to contemporary processes. The architects to include Greg Lynn, Reiser + Umemotto, Lars Spuybroek / NOX Architects, UN studio, Diller Scofidio, Dominique Perrault, Decoi, Marcos Novak, Foreign Office Architects, Asymptote, Herzog and de Meuron, Neil Denari, Serie Architects, BIG Architects. Study to be undertaken in the form of assignments/discussions/seminars/presentations.

TOTAL: 45 PERIODS

TEXTBOOKS:

Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', in Illuminations, Schocken Books, New York, 1969

Ignaci de Sola Morales,'Differences: Topographies of Contemporary Architecture', MIT Press,1997.
William J Mitchell, 'The Logic of Architecture: Design, Computation and Cognition', MIT Press, 1995.
Ali Rahim, 'Contemporary Process in Architecture', John Wiley & Sons, 2000.
Ali Rahim (Ed), 'Contemporary Techniques in Architecture', Halsted Press, 2002.

Peter Eisenmann; Diagram Diaries, Universe,1999.
Grey Lynn, 'The Folded, The Pliant and The Supple, Animate form', Princeton Arch. Press,1999.

REFERENCES:

Gillian Hunt, 'Architecture in the Cyberspace II', John Wiley & Sons, 2001.
L. Convey et al, 'Virtual Architecture', Batsford, 1995.
Rob Shields (ed.), 'Cultures of the internet: Virtual Spaces, Real Histories, Living bodies', Sage, London, 1996.
John Beckman, 'The Virtual Dimension, Architecture, Representation and Crash Culture', Princeton Architecture Press, 1998.
William J Mitchell, City of Bits: Space, Place and the Infobahn',MIT Press, Cambridge, 1995.
Marcos Novak, 'Invisible Architecture: An Installation for the Greek Pavilion', Venice Biennale, 2000.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Understand*** the impact of literature in architecture on philosophical development of design.
CO2	***Understand*** the alternative architectural methods available.
CO3	***Exposed*** to the master architects works and trace the development of evolution of their style.
CO4	Understand the spatial organization and spatial qualities of different typologies of buildings.
CO5	Knowledge of the contemporary design process and apply the same in the architectural design.
CO6	To gain knowledge of the spatial organization and articulation in the works of master architects.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H					M
	CO2		H				M				H		
	CO3	M			M				M				
	CO4		H			H						M	
	CO5	M		M							L		
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	30THMeeting of Academic Council											

PROFESSIONAL ELECTIVE V

COURSE CODE	COURSE TITLE	L	T	P/S	C

U18PEAR009	ADVANCED STRUCTURES	3	0	0	3

OBJECTIVES:

- To give an understanding of the loss of pre- stress and design requirements for determinate beams.
- To provide familiarity with the concept of industrial structures and high rise structures.
- To enable the study of concepts of tensile structures, domes, shells and folded plates.

UNIT I	PRESTRESSED CONCRETE	10

Losses of Prestress. Design requirements. Design of determinate beams.

.

UNIT II	INDUSTRIAL STRUCTURES	8

Classification, planning and layout requirements, functional requirements. Types of industrial structures- power plants, bunkers and silos, cooling towers, containment structures, chimneys. Merits.

UNIT III	HIGH–RISE BUILDINGS	7

Introduction. Load action in high rise buildings. Various structural systems. Waffle slab. Approximate analysis of frames for gravity and horizontal loadings.

UNIT IV	TENSILE STRUCTURES	10

Concept, development, laws of formation, merits and demerits of pneumatic structures. Basic principles, forms, merits and demerits of cable structures.

UNIT V	SHELLS, DOMES AND FOLDED PLATES	10

Shells of translation. Shells of revolution. Classification of shells and different forms. Domes. Types of folded plates. Space frames.

TOTAL: 45 PERIODS

TEXTBOOKS:

B.C. Punmia, 'Reinforced Concrete Structures, Vol. 1 & 2', Laxmi Publications, New Delhi, 1994.
N. Subramanian, 'Principles of Space Structures', Wheeler, 1998.
Thandavamoorthy T.S, 'Advanced Structures of Architecture', Eswar Press, 2008.
Council on Tall Buildings and Urban Habitat, 'Structural System for Tall Buildings', McGraw Hill, 1995.
Milo.S.Ketchum and Mark.A. Ketchum, 'Types and Forms of Shell Structures, 1997.

REFERENCES

P. Dayaratnam, P.Sarah, 'Prestressed Concrete Structures', Medtech, 2017.
Wolfgang Schueller, 'High Rise Building Structures', John Wiley & Sons,1976.

Frei Otto, 'Tensile Structures Volume 1 & 2' The MIT Press, 1973.
Bryan Stafford Smith, Alex Coull, 'Tall Building Structures - Analysis & Design', John Wiley, 1991.
Thomas Herzog, 'Pneumatic Structures', Crosby Lockwood Staples, London, 1977.
Bandyopadhyay J.N, 'Thin Shell Structures: Classical and Modern Analysis', New Age International, 2007.
Ramaswamy G.S, 'Design and Construction of Concrete Shell Roofs', CBS, 2005.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Principles of Pre stressing
CO2	Methods of Pre stressing
CO3	Materials used – Analysis and Losses of pre stressing, simple problems.
CO4	Principles of Post tensioning – Methods of Post tensioning
CO5	Materials used – Analysis and Losses of Post tensioning, simple problems
CO6	Prefabrication of structures

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						M					
	CO2		H				H					M	
	CO3			L				M					
	CO4	H			L								
	CO5		M			M			L				
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	27THMeeting of Academic Council											

PROFESSIONAL ELECTIVE V

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR010	STEEL ARCHITECTURE AND DESIGN	3	0	0	3

OBJECTIVES:

- To introduce the design potential of steel as a material in building construction and its inherent structural benefits.
- To inform about the various components of steel as structural and aesthetic design through case studies.
- To provide familiarity with the best practices of steel as a construction material.

.UNIT I	INTRODUCTION TO STEEL AS BUILDING MATERIAL	8

Materiality of steel, structural properties of steel, advantages of steel in construction. History of metal in construction – Iron to Steel. Steel and tension. Industrialization and mass fabrication of steel. Casting of steel in historic and contemporary examples. Invention of hollow structural sections. Hot rolled steel shapes, various hollow structural sections.

.

UNIT II	STEEL IN HIGH TECH MOVEMENT, CONTEMPORARY ARCHITECTURE	10

Introduction to High Tech movement. Understanding of various typologies of high tech movement – Extruded, Grid/Bay, Diagrids, arched/ curved structures, tensile. Advantages of diagrids over standard frames. Curved steel – creating curves in steel buildings, limitations in curving steel. Evolution of AESS (architecturally exposed structural steel) through High Tech movement.

UNIT III	STRUCTURAL EXPRESSION OF STEEL	10

Introduction to AESS (architecturally exposed structural steel), standard structural steel versus AESS. Factors that define AESS. Characteristics and categories of AESS. Connection types for AESS – bolted, welded and cast connections. Member types for AESS – Tubular and standard sections. Various steel frame design, basic connection strategies, basic understanding of steel floor systems, truss systems and braced systems.

UNIT IV	SUSTAINABILITY, STEEL AND OTHER MATERIALS	9

Introduction to steel as a sustainable material. Recycled, reuse and adaptive reuse of steel. Steel and glazing systems, support systems for glazing. Technical aspects of combining steel with glass. Various steel and glass envelope systems - curtain wall system, wind braced support systems, cable net walls, spider steel connections with structural glass, simple and complex cable systems. Handling curves and lattice shell construction. Advanced framing system – Steel and Timber. Low carbon design strategies.

UNIT V	FABRICATIONS, ERECTION AND IMPLICATIONS ON DESIGN	8

Study on transformation of architectural design into fabricated elements. Study of process profile through case studies. Role of physical and digital models in fabrication. Steel in temporary/ exhibit buildings. Need for corrosion and fire protection. Various finishes and coating systems of steel. Detailed study on corrosion protection and fire protection systems. Transportation, site issues and erection on site. Erection of beams and columns. Effects of climate and weather on erections. Other issues relating to practical implication of design on site.

TOTAL: 45 PERIODS

TEXTBOOKS

Terrimeyer Buake, 'Architectural Design in Steel', SPON, 2004.
Peter Silver et al, 'Structural Engineering for Architects', Laurence King, 2013.

REFERENCES

Victoria Ballard Bell & Patrick J Rand; 'Materials for Architectural Design', Lawrence King, 2006.
Ettinger J. Van et all(Editors), 'Modern Steel Construction in Europe', Elsevier,1963.
Leonardo Benevolo, 'History of Modern Architecture Vol 1 & 2', Reprint, MIT Press, 1977.
'Handbook of Steel Construction', Canadian Institute of Steel Construction, 2010.
John Leckie, 'Steel and Other Materials', Canadian Institute of Steel Construction, 2007.
INSDAG Publications and Brochures.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	***Design*** the Pre stressed members
CO2	***Explain*** the design concepts of Shells and folded plates
CO3	***Analyze*** the behavior of steel and R.C.C structural members
CO4	***Design*** the steel connections.
CO5	***Design*** the R.C.C structural members
CO6	Introduction of shells and folded plates

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						M					
	CO2		M				M						H
	CO3	M			M						L		
	CO4		M						L				
	CO5	M					L						
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	29THMeeting of Academic Council											

PROFESSIONAL ELECTIVE VI

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR011	ARCHITECTURAL CONSERVATION	3	0	0	3

OBJECTIVES:

- To introduce the various issues and practices of conservation in architecture.
- To provide familiarity with the status of conservation in India and the various agencies involved in the field of conservation worldwide and their policies.
- To outline the status of conservation practice in the country and the various guidelines for the preservation, conservation and restoration of buildings.
- To inform about the character and issues in Indian heritage towns through case studies.

.UNIT I	INTRODUCTION TO CONSERVATION	12

Understanding heritage. Defining conservation, preservation and adaptive reuse. Heritage conservation- need, debate and purpose. History of conservation movement. International agencies like ICCROM, ICOMOS, UNESCO and their role in conservation. Charters. Principles and ethics of conservation.

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UNIT II	CONSERVATION IN INDIA	7

Museum conservation. Monument conservation and the role of ASI, SDA, INTACH. Central and state government policies and legislations. Inventories and projects. Selected case studies of sites such as Hampi, Golconda, Mahabalipuram. Craft Issues of conservation.

UNIT III	CONSERVATION METHODS AND MATERIALS	10

Investigation techniques and tools. Behaviour of historic materials and structures. Problems with masonry, foundation. Repair methods, traditional and modern methods. Seismic retrofit, services additions and disabled access to historic buildings. Moisture and pollution problems.

UNIT IV	CONSERVATION PRACTICE	7

Listing of monuments. Documentation of historic structures. Assessing architectural character. Historic structure report. Guidelines for preservation, rehabilitation and adaptive re-use of historic structures. Case studies of palaces in Rajasthan, dwellings in Chettinad and Swamimalai. Heritage site management.

UNIT V	URBAN CONSERVATION AND CONSERVATION PLANNING DESIGN	9

Understanding the character and issues of historic towns. Selected case studies. Historic districts and heritage precincts. Conservation as a planning tool. Financial incentives and planning tools such as TDR. Urban conservation and heritage tourism. Case studies of sites like Cochin, Pondicherry French town. Conservation project management.

TOTAL: 45 PERIODS

TEXTBOOKS

Bernard Fielden, 'Conservation of Historic Buildings', Architectural Press, 2003.

Bernard Fielden, 'Guidelines for Conservation - A Technical Manual', INTACH, 1989.

MS Mathews, 'Conservation Engineering', Universitat Karlsruhe, 1998.

J. Kirk Irwin, 'Historic Preservation Handbook', McGraw Hill, 2003.

Donald Appleyard, 'The Conservation of European Cities', M.I.T. Press, Massachusetts, 1979.

Publications of INTACH

REFERENCES

James M. Fitch, Historic Preservation: Curatorial Management of the Built World by University Press of Virginia; Reprint Edition,1990.

Robert E. Stipe, 'A Richer Heritage: Historic Preservation in the Twenty-First Century, University of North Carolina Press, 2003.

B.P. Singh, 'India's Culture- The State, The Arts and Beyond', Oxford University Press, 2000

A.G. K. Menon (Ed), 'Conservation of Immovable Sites', INTACH Publication, N. Delhi.

John H. Stubbs and Emily G Makas; Architectural Conservation in Europe and the Americas, John Wiley & Sons, 2011.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	The recognition and protection of the historic environment to gain awareness
CO2	Understands the techniques and the theoretical frame which are essential for preparing the documentation work besides the restoration projects of the cultural heritage.
CO3	Improves the critical point of view using the examples.
CO4	Realizes the necessity of sustainable design: sustainability in architecture and urban design decisions and areas of natural
CO5	Realizes the responsibilities of legaslation aspects.
CO6	Culturally significant buildings, including the artificial protection of resources and the creation of healthy buildings and settlements

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M					M	
	CO2		M					L					M
	CO3	M			H						L		
	CO4		M				L						M
	CO5	M				L					M		
3	Category	PE											
4	Approval	26THMeeting of Academic Council											

PROFESSIONAL ELECTIVE VI

COURSE CODE	COURSE TITLE	L	T	P/S	C
U18PEAR012	ARCHITECTURAL JOURNALISM AND PHOTOGRAPHY	3	0	0	3

OBJECTIVES:

- To introduce general skills necessary for the practice of professional journalism.
- To introduce the fundamentals of writing, explain different strategies and their criticism.
- To give particular exposure to architectural journalism.
- To introduce photojournalism, bring out importance/ contributions of photography in the architectural profession and to help develop proficiency in modern photography techniques.

UNIT I	INTRODUCTION	9

Introduction to journalism, key concepts and objectives of journalism. Specialised journalism with emphasis on architectural journalism. Journalism skills: research, reporting, writing, editing, photography, columnists, public relationships, criticism. Issues such as copyright, public art policy, the arts and urban redevelopment. Introduction to local culture scene.

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UNIT II	TECHNOLOGIES IN JOURNALS	9

Environment, social change, persuasion. Interviewing techniques, argument and debate as a technique in the investigation of social problems. Evidence, proof, refutation, persuasion. Training in argumentative speaking. Introduction to software needed in journalism and photography, video coverage, walk-through of buildings, production of contemporary architectural journalism. Understanding the individual demands in the context of newspapers, radio, film, and television.

UNIT III	CONTEMPORARY ARCHITECTURAL JOURNALISM	9

Role of the editor. Editing of articles, features and other stories. Editing for online newspaper and magazines. Text preparation, mode of presentation, standards and guidelines for documentation. Code of ethics. Basic knowledge on press laws, Press Council of India. Multimedia/ online journalism and digital developments.

UNIT IV	DISCUSSIONS AND ISSUES	9

Regional, national and international discussion forums. Changes in contemporary and historical design practices. Discussions on topics needed in an architectural journal and current issues. Types of journals. Works of key architectural journalists. Public discourse on the internet. Mass media and public opinion. Critique on selected pieces of journalism.

UNIT V	ARCHITECTURAL PHOTOGRAPHY	9

Introduction to architectural photography and role of the photographic image in the global world. Equipment - cameras and lenses. Techniques- film speed, exposure measurement, gray scale, photo-finishing and editing digital images. Perspectives- single point, two- point, three- point and methods of correcting distortions. Lighting - external and interior

.

TOTAL: 45 PERIODS

TEXTBOOKS:

Edward Jay Friedlander and John Lee, 'Feature Writing for Newspapers and Magazines', 4th edition, Longman, 2000.

David Fuller & Patricia Waugh, eds., 'The Arts and Sciences of Criticism', Oxford: Oxford University Press, 1999.

James Foust, 'Online Journalism Principles and Practices of News for the Web', Holcomb Hathaway Publishers, Scottsdale, AZ, 2005.

M. Harris, 'Professional Architectural Photography', Focal Press, 2001.

M. Harris, 'Professional Interior Photography', Focal Press, 2002

REFERENCES:

Martin Huckerby, 'The Net for Journalists: A Practical Guide to the Internet for Journalists in Developing Countries'. UNESCO/Thomson Foundation/ Common wealth Broadcasting Association, 2005.

S. J. A.Ward, 'Philosophical Foundations of Global Journalism Ethics', Journal of Mass Media Ethics, Vol. 20, No. 1, 3-21, 2005.

M. Heinrich, 'Basics Architectural Photography', Bikhauser Verlag AG, 2008.

Gerry Kopelow, 'Architectural Photography: The Professional Way', Princeton Architectural Press, 2007.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Discuss the history of Photography, moving images and Photo Journalism
CO2	Demonstrate a brief understanding of news values, photo journalism and sources.
CO3	Explain various types of cameras, its components and accessories
CO4	Discuss the legal and ethical aspects of photography and photojournalism.
CO5	Assess the importance of digital technology in photography
CO6	Critically analyse and appreciate photographs

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			M			L					
	CO2		H				H				L		
	CO3	L		L		M							
	CO4		M		M							L	
	CO5	M					M						H
3	Category	PE											
4	Approval	25THMeeting of Academic Council											

CURRICULUM AND SYLLABUS (R2018)

CHOICE BASED FLEXIBLE CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

B.Tech – GENETIC ENGINEERING

(FULL TIME)

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	4	0	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
8	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
PHYSICAL ACTIVITY BASED COURSES								
9	18MCAC101	MC	Physical health – Sports & Games	2	0	0	2	0
10	18MCAC102	MC	Gardening & Tree Plantation -	2	0	0	2	0
Total				31	17	0	14	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	2	1	1	0	2
2	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	4	0	0	4
3	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
4.	U18BSGE201	ES	Cytology And Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18MCTH201	MC	Environmental Sciences	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
8	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
9	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
PHYSICAL ACTIVITY BASED COURSES								
10	U18MCAB203	MC	Yoga	2	0	0	2	0
11	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
Total				30	14	1	15	24.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
S.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA305	BS	Transforms and Numerical methods	4	3	1	0	4
2	U18PCGE301	PC	Enzyme Technology	4	3	1	0	4
3	U18PCGE302	PC	Principles of Genetic Engineering	3	3	0	0	3
4	U18PCGE303	PC	Introduction to molecular Techniques	3	3	0	0	3
5	U18PCGE304	PC	Microbiology	3	3	0	0	3
6	U18PCGE305	PC	Basics of Biochemistry	3	3	0	0	3
PRACTICAL								
7	U18PCGE3L1	PC	Microbiology Laboratory	3	0	0	3	1.5
8	U18PCGE3L2	PC	Biochemistry Laboratory	3	0	0	3	1.5
Total				26	18	2	6	23
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCGE401	PC	rDNA Technology	3	3	0	0	3
2	U18PCGE402	PC	Molecular Biology	3	3	0	0	3
3	U18PCGE403	PC	Genomics and Proteomics	3	3	0	0	3
4	U18PCGE404	PC	Basics of Bioinformatics	3	3	0	0	3
5	U18PCGE405	PC	Plant Tissue Culture					
6	U18HSBA401	HS	Organizational Behavior	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0

PRACTICAL								
8	U18PCGE4L1	PC	rDNA Technology Lab	3	0	0	3	1.5
9	U18PCGE4L2	PC	Molecular Biology Lab	3	0	0	3	1.5
10	U18PCGE4L3	PC	Plant Tissue culture Laboratory	3	0	0	3	1.5
Total				30	20	1	9	23.5
ACTIVITY BASED COURSES								
11	U18MCAB406	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB407	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0

SEMESTER V								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA501	PC	Biostatistics	4	3	1	0	4
2	U18PCGE501	PC	Immunology	3	3	0	0	3
3	U18PCGE502	PC	Genes and diseases	4	3	1	0	4
4	U18PCGE503	PC	Virology	3	3	0	0	3
5		OE	Open Elective-1	3	3	0	0	3
6	U18MCTH501	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
7	U18PCGE5L1	PC	Immunology lab	3	0	0	3	1.5
8	U18PCGE5L2	PC	Protein Biochemistry lab	3	0	0	3	1.5
9	U18PCGE5L3	PC	Genomics lab	3	0	0	3	1.5
Total				27	17	1	9	20.5
ACTIVITY BASED COURSES								
10	U18MCAC610	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAC611	MC	Self-Development - religion and Inter-faith	2	0	0	2	0

SEMESTER VI								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCGE601	PC	Research Methodology	3	3	0	0	3
2	U18PCGE602	PC	Molecular evolution and Phylogeny	3	3	0	0	3
3	U18PCGE603	PC	Cytogenetics	3	3	0	0	3
4		PE	Professional Elective - 1	3	3	0	0	3
5		OE	Open Elective-2	3	3	0	0	3
6	U18MCTH601	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
7	U18PCGE6L1	PC	Gene Cloning Laboratory	3	0	0	3	1.5
8	U18PCGE6L2	PC	Bioinformatics lab	3	0	0	3	1.5
9.	U18EEGE 6L3	EE	Technical Seminar	2	0	0	2	1
10	U18EEGE6L4	EE	Summer Internship	During Summer Vacations / Non-credit				

Total				22	17	0	5	19
ACTIVITY BASED COURSES								
10	U18MCAB508	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB509	MC	Social Services – NSS	2	0	0	2	0

SEMESTER VII

Sl.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCGE701	PC	Animal Cell Culture and Transgenic Technology	3	3	0	0	3
2		PE	Professional Elective - 2	3	3	0	0	3
3		PE	Professional Elective - 3	3	3	0	0	3
4		PE	Professional Elective - 4	3	3	0	0	3
5		OE	Open Elective-3	3	3	0	0	3
PRACTICAL								
6	U18PRGE7P1	EE	Project Stage-I	6	0	0	6	3
7	U18PCGE7L1	PC	Animal Cell Culture Laboratory	4	0	0	4	2
Total				22	17	0	5	19
ACTIVITY BASED COURSES								
8.	U18MCAB610	MC	Self-Development –Spiritual, Mindfulness & Meditation	2	0	0	2	0
9.	U18MCAB611	MC	Self-Development - religion and Inter-faith	2	0	0	2	0

SEMESTER VIII

Sl. No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1		OE	Open Elective (MOOC)	2	2	0	0	2
2		PE	Professional Elective -5	3	3	0	0	3
3		PE	Professional Elective -6	3	3	0	0	3
PRACTICAL								
4	U18PRGE8P1	EE	Project Stage-II	18	0	0	18	9
			Total	26	6	0	22	17
ACTIVITY BASED COURSES								
5	U18MCAB814	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0

PROFESSIONAL ELECTIVE –1 (Semester VI)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PEGE011	Medical Genetics	Human Genetics	3	3	0	0	3
2	U18PEGE012	Clinical Genetics	Animal Tissue engineering	3	3	0	0	3
3	U18PEGE013	Plant Genetic Engineering	Classical and molecular Plant Breeding	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2 (Semester VII)								
Sl. No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PEGE021	Medical Genetics	Cancer Biology	3	3	0	0	3
2	U18PEGE022	Clinical Genetics	Agri, Veterinary and Medical Informatics	3	3	0	0	3
3	U18PEGE023	Plant Genetic Engineering	Genetic Engineering of Plants	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3(Semester VII)								
Sl.No.	**Code No.**	**Specialisation**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PEGE031	Medical Genetics	Molecular Medicine and Hereditary disorders	3	3	0	0	3
2	U18PEGE032	Clinical Genetics	Microbial Genetics	3	3	0	0	3
3	U18PEGE033	Plant Genetic Engineering	Herbal Drugs and Genomics	3	3	0	0	3

PROFESSIONAL ELECTIVE - 4(Semester VII)								
Sl.No.	**Code No.**	**Specialisation**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**

1	U18PEGE041	Medical Genetics	Pharmacogenomics	3	3	0	0	3
2	U18PEGE042	Clinical Genetics	Protein Engineering	3	3	0	0	3
3	U18PEGE043	Plant Genetic Engineering	Bioconfinement of genetically modified organisms	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5 (Semester VIII)								
Sl.No.	**Code No.**	**Specialisation**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PEGE051	Medical Genetics	Stem cell Biology	3	3	0	0	3
2	U18PEGE052	Plant Genetic Engineering	Stress tolerance in Plants	3	3	0	0	3
3	U18PEGE053	Clinical Genetics	Food process Technology and Quality control	3	3	0	0	3

PROFESSIONAL ELECTIVE – 6 (Semester VIII)								
Sl.No.	**Code No.**	**Specialisation**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PEGE061	Medical Genetics	Metabolism and Metabolomics	3	3	0	0	3
2	U18PEGE062	Clinical Genetics	Industrial Microbiology	3	3	0	0	3
3	U18PEGE063	Plant Genetic Engineering	Plant Physiology	3	3	0	0	3

* OPEN ELECTIVES FROM GENETIC ENGINEERING

OPEN ELECTIVE								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18OEGE001	OE	Metagenomics and Epigenomics	3	3	0	0	3
2	U18OEGE002	OE	Molecular Genetics and Genomics	3	3	0	0	3
3	U18OEGE003	OE	Principles of Molecular cell biology	3	3	0	0	3

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management courses (HS)	3	2	-	3	-	-	-	-	8	6.3
2	Mathematics & Basic Sciences (BS)	10	13	4	-	-	-	-	-	27	6.5
3	Engineering Sciences (ES)	7.5	6.5	-	-	-	-	-	-	14	5.9
4	Professional Core (PC)	--	-	19	20.5	17.5	12	5	-	74	7.0
5	Core Electives (CE)	-	-	-	-	-	3	9	6	18	5.5
6	Open Electives (OE)	-	-	-	-	3	3	3	-	9	4.2
7	Massive Open Online Course(MOOC)	-	-	-	-	-	-	-	2	2	4.2
8	Employment Enhancement Courses (EEC)	-	-	-	-	1	3	3	9	16	4.7
9	Mandatory courses(MC)	0	0	0	0	0	0	0	0	0	0
	Total Credit	20.5	24.5	23	23.5	20.5	19	19	17	167	20.5
	Total Contact Hours	31	30	26	30	27	22	22	28	216	27

HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	2	1	1	0	2
3	U18HSBA401	HS	Organizational Behavior	3	3	0	0	3
Total credits								8

BASIC SCIENCE COURSES (BS)

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
THEORY								
1	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	4	0	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	4	0	0	4
5	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
6	U18BSMA305	BS	Transforms and Numerical methods	4	3	1	0	4
PRACTICAL								
1	*U18BSPH2L3	BS	Wave Optics and BioPhysics Lab	3	0	0	3	0
2	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
Total credits								21

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18BSGE201	ES	Cytology And Genetics	2	2	0	0	2
4	U18ESEE201	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
PRACTICAL								
1	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
2	U18ESEE101	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
3	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
4	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
Total Credits								18.5

PROFESSIONAL CORE COURSES

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCGE301	PC	Enzyme Technology	4	3	1	0	4
2	U18PCGE302	PC	Principles of Genetic Engineering	3	3	0	0	3
3	U18PCGE303	PC	Immunology	3	3	0	0	3
4	U18PCGE304	PC	Microbiology	3	3	0	0	3
5	U18PCGE305	PC	Basics of Biochemistry	3	3	0	0	3
6	U18PCGE401	PC	rDNA Technology	3	3	0	0	3
7	U18PCGE402	PC	Molecular Biology	3	3	0	0	3
8	U18PCGE403	PC	Genomics and Proteomics	3	3	0	0	3

9	U18PCGE404	PC	Genes and Diseases	3	3	0	0	3
10	U18BSMA401	PC	Mathematics-IV	4	3	1	0	4
11	U18PCEGE501	PC	Industrial Biotechnology	3	3	0	0	3
12	U18PCGE502	PC	Research Methodology	3	3	0	0	3
13	U18PCGE503	PC	Protein Engineering	4	3	1	0	4
14	U18PCGE504	PC	Plant Tissue Culture	3	3	0	0	3
15	U18PCGE601	PC	Bio-Pharmaceutical Technology	3	3	0	0	3
16	U18PCGE603	PC	Molecular evolution and Phylogeny	3	3	0	0	3
17	U18PCGE604	PC	Cytogenetics	3	3	0	0	3
18	U18PCGE701	PC	Animal Cell Culture and Transgenic Technology	3	3	0	0	3
PRACTICALS								
18	U18PCGE3L1	PC	Microbiology Laboratory	3	0	0	3	1.5
19	U18PCGE3L2	PC	Biochemistry Laboratory	3	0	0	3	1.5
20	U18PCGE4L1	PC	rDNA Technology Lab	3	0	0	3	1.5
21	U18PCGE4L2	PC	Molecular Biology Lab	3	0	0	3	1.5
22	U18PCGE4L3	PC	Genomics lab	3	0	0	3	1.5
23	U18PCGE5L1	PC	Immunology lab	3	0	0	3	1.5
24	U18PCGE5L2	PC	Protein Biochemistry lab	3	0	0	3	1.5
25	U18PCGE5L3	PC	Plant Tissue culture Laboratory	3	0	0	3	1.5
26	U18PCGE6L1	PC	Gene Cloning Laboratory	3	0	0	3	1.5
27	U18PCGE6L2	PC	Bioinformatics Laboratory	3	0	0	3	1.5
28	U18PCEE7L1	PC	Animal Cell Culture Laboratory	4	0	0	4	2

Total Credits	74

MANDATORY COURSES (MC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18MCTH201	MC	Environmental Sciences	3	3	0	0	0
2	U18MCTH401	MC	Constitution of India	2	2	0	0	0
3	U18MCTH501	MC	Universal Human Values	2	2	0	0	0
4	U18MCTH601	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
ACTIVITY BASED COURSES								
1	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
2	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	18MCAC201	MC	Yoga	2	0	0	2	0
4	18MCAC202	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB301	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB302	MC	Culture – Intangible Cultural, heritage(festivals , Food ways, Local games)	2	0	0	2	0
7	U18MCAB401	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
8	U18MCAB402	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
9	U18MCAB501	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB502	MC	Social Services – NSS	2	0	0	2	0
11	U18MCAB601	MC	Self Development		0	0	2	

			– Spiritual, Mindfulness & Meditation	2				0
12	U18MCAB602	MC	Self Development - religion and Inter-faith	2	0	0	2	0
13	U18MCAB701	MC	Behavioral and interpersonal skills	2	0	0	2	0
14	U18MCAB702	MC	Nature – Nature club	2	0	0	2	0
15	U18MCAB801	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total number of periods								30

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing oneself – exchanging personal information- narrating events, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development-synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas-dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures-Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 15

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations

3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. **Practical English Usage. Michael Swan. OUP. 2005.**
6. **Remedial English Grammar. F.T. Wood. Macmillan.2007**
7. **On Writing Well. William Zinsser. Harper Resource Book. 2001**

COURSE OUTCOMES												
CO1	The student will be able to comprehend the text with clarity											
CO2	The capacity to read and listen will improve											
CO3	Writing technical report will be learnt properly											
CO4	Speaking skills will be acquired											
CO5	Overall communication skills will make them employable											
MAPPING BETWEEN COURSE OUTCOMES&PROGRAMME OUTCOMES												
COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	S										**S**	
2		**M**							**M**			
3			**S**							**S**		**M**
4				**S**		**M**						
5					**S**		**S**	**W**				**S**
Category	Humanities and Social Studies (HS)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSMA102	Mathematics I for Bio Engineering	L	T	P	C
	Total Contact Periods - 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The aim is to develop mathematical curiosity and use inductive and deductive reasoning when solving problems, and to develop the knowledge, skills and attitudes necessary to pursue further studies in Mathematics and to become confident in using Mathematics to analyze and solve problems in real – life situations.				

UNIT I THEORY OF EQUATIONS (9+3)

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3)

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., Manickavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

	COURSE OUTCOMES (COs)
CO1	Solve the equations (such as linear, factorable, quadratic and rational), applications and linear inequalities, to know the formation of equations.
CO2	Use both the limit definition and rules of differentiation to differentiate functions.The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions
CO4	Compute definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gamma
CO5	Identify Eigen value problems from practical areas using transformations;

CO/PO Mapping:S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	S			W	M							
CO2	S				M		W			W		M
CO3	S				M				W			
CO4	S		S	W	M			M				S
CO5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS **9**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)													
CO1	Understand the basic concept of waves and lights												
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing												
CO3	Understand the propagation of light and geometrical optics												
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves												
CO5	Understand the concept of laser and its applications												
Mapping of Course Outcomes with Programme Outcomes (POs) **S – Strong, M – Medium, W – Weak**													
1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S	S	M	S	M			M	S	S		
	CO2	W	S	M	M	S			M		W	S	M
	CO3	S	W			W			M	M		M	
	CO4	S	W			W			M	M		M	S
	CO5	S	M	M	M				M		S	W	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis

of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	S			M		S		S		W		
CO2		W	S		M		S		M		W	
CO3		M		S		W				M		S
CO4	S		M	W			M			S		
CO5		S		W		M				S		M
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18ESCS101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr,–An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S	S	S	M	S	M	W		M	W	M	M
	CO2	S	S	M	M		M		W			M	
	CO3	M	M	W	S	M		W		W		M	
	CO4	M	M	W	M	S	M	W	M	W		M	
	CO5	M	S	W	M	M			M	M	W		S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet des needs, using the techniques, skills, and modern engineering tools necessary engineering practice				

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypocycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of Points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE 4:SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple Position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students willgetExposure to basics of building construction
CO4	Students willgetExposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S			M			S					
	CO2	S	S	W		S	M						M
	CO3			S									
	CO4											S	S
	CO5	S						W					
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S	S	M	S	S	M	M	M	M		M	M
	CO2	S	S	W	S	S	M	W	M	M	M	M	
	CO3	S	S	M	M	M	M		M	M	M	M	
	CO4	S	M	S	S	S	M	M	M	M	W		
	CO5	S	S	M	S	M	M		M	M	W	M	S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSPH2L3	**Wave Optics and Bio Physics Laboratory (Common to B.Tech- IBT, GE & Agri Bio Tech)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Wave Optics and Bio Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Biophysics – Bio-Engineering branches

1. Determination of optical rotation using polarimeter
2. Determination of diffusion potential of biological sample

3. Analysis of viscosity of different biological sample using viscometer
4. Analysis of protein concentration using calorimeter
5. Quantification of DNA using UV-Vis spectrophotometer
6. Analysis of absorption maxima for an unknown sample

Course Outcome (CO's)													
CO1	Understand the fundamental concept of optics												
CO2	Understand the concept of production of ultrasonic waves												
CO3	Understand the estimation and functions of Biomolecules												
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak													
1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S		S	S				S	W	M		M
	CO2	S	S	W					S	W	M		
	CO3				S				S	M	W		S
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a Polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COs WITH POs: S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	S		M	M		S		S		W		M
CO2	W	S			M		S		M		W	
CO3		M		M						M		S
CO4	S		M				M				S	
CO5		S		W		M				S		

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18HSEN201	TECHNICAL ENGLISH	L	T	P	C
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				

OBJECTIVES

To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions – listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology.OrientBlackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

Upon completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M										**S**	**S**
2		**S**							**M**			
3			**S**							**S**		
4				**M**		**S**						**M**
5					**M**		**M**	**W**				

Category	Basic Science (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

	Mathematics II for Bio Engineering (Common to IBT, Genetics and Agricultural Bio Tech)	L	T	P	C
U18BSMA202	Total Contact Periods - 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	To make the students learn Mathematics in order to formulate and solve problems effectively in their respective fields of engineering.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Integration of vector function - Green's theorem in a plane – Gauss divergence theorem and Stoke's theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions,Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO3	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO4	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping:S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	M		W		S				M		S	
CO2	S	M			S				W			M
CO3	S	M			S			M		W		
CO4	S		W				M		S			
CO5	S		W	W			M				S	S
Cate	Basic Science (BS)											
Appr	47th Meeting of the Academic Council Meeting held in Aug, 2018											

U18BSPH203	INTRODUCTION TO BIOPHYSICS	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES:
To impart theories and methods of Physics to understand the functioning of Biological system

UNIT 1 ATOMIC PHYSICS **9**

Atom model - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - spatial quantisation - Bohr magneton - Stern and Gerlach experiment.

UNIT 2 NUCLEAR PHYSICS **9**

Nuclear size, shapes and forces: Nuclear size determination - Electron scattering method- electric moments - magnetic moments - Nuclear forces - Models of nuclei – Liquid drop model of nuclei- Atomic masses and its significance.

UNIT 3 RADIATION BIOPHYSICS **9**

Basics of Radiation Physics Atomic structure models, Constituents of atomic nuclei, Isotopes, Isobars, Isotones, Radioactivity, law of Radioactivity, General properties of alpha, beta and gamma radiations, Radiation units: Units of measurement of radioactivity. Curie, Becquerel., Interaction of radiation with matter: Excitation and ionization, Photo electric effect, Compton Effect, pair production, Characteristic radiation.

UNIT 4 MEMBRANE BIOPHYSICS 9

Membrane potentials Cell surface charge, Resting membrane potential, Action potential, Ionic transport during Action Potential, properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, total electrochemical potential.

UNIT 5 MOLECULAR BIOPHYSICS 9

Nucleic acids – Purine and Pyrimidine bases, nucleosides, nucleotides basic difference in structures and functions of DNA and RNA

Proteins– Amino acids – types, planarity of peptide bond – Ramachandran map - Primary, secondary, tertiary and quarternary structures of proteins.

REFERENCE BOOKS:

1. R.Murugeshan and KrithigaSivaprasath, "Modern Physics", S.Chand publisher, 2016 (for Unit 1& 2)
2. Brij and Subramanian, "Atomic and Nuclear Physics" , S.Chand publisher, 2008 (for Unit 1 & 2)
3. JB Rajam, "Atomic Physics", 7th Edition, S.Chand publisher, 2005 (for Unit 1)
4. M.Volkenstein "General Biophysics" 1st Edition, Academic press, 1983 (for Unit 4)
5. Voet and Voet, "Introduction to Biochemistry" , 5th Edition, John Wiley & sons Inc., 2016 (for Unit 5)
6. Branden and Tooze, "Introduction to Protein Structure"2nd edition, Garland publishing, 1999
7. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014

Course Outcome (COs)													
CO1	Understand the fundamental concept of Atomic Physics												
CO2	Understand the basic concept of Nuclear Physics												
CO3	Understand the Radiation Physics and its measurement												
CO4	Understand the Membrane Biophysics with functions of different potentials												
CO5	Understand the Structural and molecular Biophysics												
Mapping of Course Outcomes with Programme Outcomes, S – Strong, M – Medium, W – Weak													
1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	W	W	W					S	W	M		
	CO2	W	W	W					S	W	M		M
	CO3	W	W	W					S	W	M		
	CO4	W	W	W					S	W	M		
	CO5				M				S	W	W		S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSGE201	CYTOLOGY AND GENETICS	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES: To provide a basic understanding of cell, its structure, function, types and about its culture					

UNIT I CELL STRUCTURE AND ORGANELLES 6

Cells - definition - eukaryotic cell and prokaryotic cell- Relationship and evolution of eukaryotic cell and prokaryotic cell- plant cells and animal cells - Cell Organelles, Structure and function – Nucleus- Endoplasmic reticulum - Golgi complex- lysosomes- cell membranes- chloroplast- mitochondria.Cell cycle-Mitosis and meiosis

UNIT II CELLULAR TRANSPORT 6

Transport across cell membranes – classification – Active and passive transport. Active – Na+ K+ ATPase Pump - Lysosomal and Vacuolar pumps - Endocytosis and Exocytosis transport across prokaryotic membrane - Cotransport – Symport, antiport.

UNIT III CELL SIGNALING AND SIGNAL TRANSDUCTION 6

Cell signaling – various kinds of Receptors and ligands –Different modes of action of ligands- different modes of signal transduction and amplification with examples- signaling through G-Proteins (Monomeric and trimeric), signaling for growth factors- secondary messengers- protein kinases- Ca ions and cAMP molecule in signaling.

UNIT IV BASICS OF GENETICS AND CHROMOSOMES 6

Mendelian Laws - Mendel's experiment - monohybrid cross-phenotype – genotype - Dihybrid inheritance - Chromosome structure and organization in prokaryotes and eukaryotes - chromosome banding - chromosome abnormalities

UNIT V ALLELES 6

Classical concepts of Pleomorphism - Multiple alleles, ABO blood groups - Rh factor - sex linkage in Drosophila- mechanism of sex determination- sex differentiation

TEXT BOOKS:

1. The Cell, Geoffrey M. Cooper & Robert E. Housman, Sinauer Associates Inc, 2015.
2. Genetics, Monroe W. Strickberger, Pearson Education India, 2015.

REFERENCE BOOKS:

1. Molecular Biology of the Cell, John Wilson and Tim Hunt, Garland science, 2014.
2. Cell Biology and Histology, Leslie P.Gartner and James L.Hiatt, Wolters Kluwer, 2014.
3. Principles of Genetics, Eldon John Gardener et al., Wiley publications, 2006.

COURSE OUTCOMES (COs)	
CO1	To understand the fundamentals of the structure of cells
CO2	To study the types and functions of cell organelles
CO3	To comprehend the methods involved in the cellular transport
CO4	To know the cause, and methods of cell signaling
CO5	To give a basic knowledge of cell culture and its applications
CO6	To understand about signal transduction
Mapping of Course Outcomes with Program outcomes (POs)	

S-Strong, M-Medium, W-Weak													
1	**COs/PO**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S					M	M	S				M
	CO2	S			M			M		M			
	CO3	M	M								M		
	CO4	S		M				S				M	S
	CO5	S					M					S	
	CO6	S			S				S		M		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition. 2017.

2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W- Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S	W			M				S		W	
	CO2	S	W			M				S		W	S
	CO3	S	M			M				S		W	
	CO4	S	W			M				S		W	
	CO5	S	W			M				S		W	M
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management.				

	• To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: Population growth, variation among nations, population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and

AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	S			M		S		S		W		
CO2	W	S	S		M		S		M		W	M
CO3		M				W			S	M		
CO4	S		M	W			M				M	
CO5		S		W		M				S		S

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESME1L2	WORKSHOP/MANUFACTURING PRACTICES LABORATORY	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

1. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

2. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

3. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1											S	
	CO2			S	M							S	M
	CO3		M										
	CO4	S			W							S	S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer

7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipments and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flops

Mappingof Course Outcomes (COs) with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S- Strong, M-Medium, W- Weak

1	**COs/POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	S	S			S				S		M	
	CO2	S	S			S				S		M	M
	CO3	S	S			S				S		M	
	CO4	S	S			S				S		M	
	CO5	S	S			S				S		M	S
	CO6	S	S			S				S		M	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSMA305	Transforms and Numerical Methods	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Basic Mathematics				
	Course Designed by – Mathematics Department				

OBJECTIVES

1. Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.
2. Understand the problems using Fourier transform and their properties.
3. Ability to apply knowledge of mathematics, science and engineering.
4. Ability to analyze and interpret data.
5. Identify, formulate and solve equations by various methods.

MODULE I FOURIER SERIES (12 Periods)

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series, Parseval's Identity – Harmonic Analysis.

MODULE II FOURIER TRANSFORMS (12 Periods)

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

MODULE III SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS (12 Periods)

Bisection method, Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan , Jacobian and Gauss-Siedel methods.

MODULE IV INTERPOLATION (12 Periods)

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

MODULE V NUMERICAL DIFFERNTIATION AND INTEGRATION (12 Periods)

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. Sastry.SS "Introductory Numerical Methods" PHI, 2010.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4^{th} Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36^{th} Edition, 2001
3. Curtis F.Gerald. "Applied Numerical Analysis" 7th Edn. Pearson Education, Chennai- 600113.

4. Dennis G.Zill and Warren S.Wright. "Advanced Engineering Mathematics". 3rd Edn. Jones & Bartlett Publishers, UK. 1992 4 . www.mathforcollege.com.
5. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand & Company, 2nd Edition 2010.

COURSE OUTCOMES (COs)	
CO1	Can able to do fourier series.
CO2	Understanding of Fourier Transforms
CO3	Able to bring solution of polynomial Equation
CO4	Understanding of transcendental equations
CO5	Detection and understanding of interpolation
CO6	Able to perform Numerical Differentiation And Integration

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H		H	M		H		M	H		H
	CO2		H						H			H	
	CO3	H			H			H		H	H		H
	CO4	H	H						M				H
	CO5					H		H		H	M		
3	Category	Basic Studies (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE301	**ENZYME TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Molecular Biology, Biopharmaceutical technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	1. To understand the basics of enzymes and classification and enzyme kinetics 2. To study the production, purification and characterization of enzymes 3.To study the Instrumental Techniques In Enzymatic Analysis				

MODULE 1: INTRODUCTION (12 periods)

Classification, Structure and functions of Enzymes. Specificity of enzyme action, Factors modifying enzyme activity, biotechnological applications of enzymes and applications of enzymes in various industries.

MODULE II: CHEMICAL NATURE OF ENZYME CATALYSTS (12 periods)

Structural Components of Enzymes – Structure, apoenzymes, prosthetic group, cofactors, Metal activated enzymes – metalloenzymes –involvement of coenzymes.

MODULE III: FREE AND IMMOBILISED ENZYME KINETICS (12 periods)

Pre-steady state kinetics, Kinetics of single substrate reactions, Kinetics of multi-substrate reactions, turnover number, Enzyme Inhibition, Methods of immobilization of enzymes. Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model.

MODULE IV: EXTRACTION AND PURIFICATION OF ENZYMES (12 periods)

Methods of production of enzymes, Extraction of Enzymes, soluble enzymes, membrane bound enzymes, Nature of extraction medium, purification of enzyme, criteria of purity, Determination of molecular weight of enzymes.

MODULE V: INSTRUMENTAL TECHNIQUES IN ENZYMATIC ANALYSIS (12 periods)

Principles – Manometry – Spectrophotometry – Spectrofluorimetry – Electrochemical methods – Enthalpimetry– Radio chemical methods – Automation in enzymatic analysis.

TEXT BOOKS

1. Principles of Fermentation technology – Stanbury, 2nd edition, 2003
2. Enzyme technology by Martin F. Chaplin, C. Bucke
3. Methods in Enzymology vol. 152 by S.L. Berger and A.R. Kimmel.

REFERENCE BOOKS

1. Enzymes by Trevor palmer
2. Enzymes by Robert A. Copeland, 2nd edition.

COURSE OUTCOMES (COs)	
CO1	Understand the basics of enzymes, nomenclature and classification
CO2	Apply the knowledge to derive the kinetics for enzymes
CO3	Learn and apply the different techniques for immobilization of enzymes and kinetics
CO4	To gain knowledge in various enzyme kinetics
CO5	Study and apply the knowledge on design of enzyme reactors
CO6	Discuss the applications of enzymes in Instrumental Techniques In Enzymatic Analysis

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M				M	H		H
	CO2		M								H		H
	CO3			M		M				H	H		H
	CO4		M							H	H		H
	CO5		H	M		M				H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

	PRINCIPLES OF GENETIC ENGINEERING	L	T	P	C
U18PCGE302	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Recombinant DNA technology, Principles of Genetics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	1. To learn various types of vector-host systems and steps in creating a recombinant DNA molecule 2. To gain knowledge on various recombinant DNA techniques and their applications.				

MODULE I: SCOPE OF GENETIC ENGINEERING (9 Periods)

Basics, guidelines and Milestones in Genetic Engineering. Bio safety issues, Molecular Tools in Genetic Engineering – Medical Genetics, Restriction mapping of DNA fragments and Map construction, nucleic acid Amplification (PCR analysis) and its applications. Real time PCR.

MODULE II: GENE CLONING STRATEGIES (9 Periods)

Restriction enzymes and DNA Modifying enzymes (Polymerases, Reverse Transcriptase, Ligases, Alkaline phosphatase, Terminal deoxynucleotide transferases, Nucleases - S1 nucleases etc.). Gene Cloning vectors, Gene Cloning strategies, Transformation and selection of recombinants; Construction of DNA libraries.

MODULE III: GENE EXPRESSION (9 Periods)

Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays. Gene expression in bacteria and Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants – characterization of recombinant proteins, stabilization of proteins; Phage display, Yeast Two- and three Hybrid system.

MODULE IV: TRANSGENIC TECHNOLOGY (9 Periods)

Principles and Scope of Transgene technology, Gene tagging (T-DNA tagging and Transposon tagging), gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies, Transgenic plants.

MODULE V: GENONIMCS AND FORENSICS (9 Periods)

Role of Genetic Engineering in Forensic Medicine. Nucleic acid sequencing, NGS, Genetic defects and detection; DNA profiling.

TEXT BOOKS:

1. Gene Cloning and DNA Analysis, An Introduction. T.A.Brown, Wiley –Blackwell publication, 2010.
2. Principles of Gene Manipulation and Genomics, Sandy B. Primrose, Richard M. Twyman, Blackwell Scientific Publication, 2009

REFERENCE BOOKS:

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. DNA Cloning: a Practical Approach, .M. Glover and B.D. Hames, IRL Press, Oxford.
4. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego.
5. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego.

COURSE OUTCOMES (COs)	
CO1	Understand the steps in Biopharmaceutical industries
CO2	Explain the features of Transformation and selection of recombinants
CO3	Characterization of recombinant proteins
CO4	Chromosome engineering, Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation
CO5	Role of Genetic Engineering in Forensic Medicine
CO6	Understand the steps in mutational studies

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H			M		H		M	H		H
	CO2		M								H		H
	CO3			M		M		M		H	H		H
	CO4		M					H		H	H		H
	CO5			M		M		M		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE303	Introduction to Molecular Techniques	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Recombinant DNA technology, Principles of Genetics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	1. To learn various types of PCR 2. To gain knowledge on various DNA and RNA isolation procedures.				

MODULE I – NUCLEIC ACID ISOLATION AND AGAROSE GEL ELECTROPHORESIS (9 Periods)

Conventional and kit methods for isolation of nucleic acids - Plasmid DNA – Genomic DNA from Bacterial cells, Plant cells, Animal cells – RNA isolation and mRNA purification – Agarose gel electrophoresis – Staining techniques – Pulse field gel electrophoresis.

MODULE II - PCR TECHNIQUES (9 Periods)

Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR -Gene specific primer and degenerate primer – Inverse PCR, Hot-start PCR, Loop mediated PCR -, Reverse transcription PCR and Real time PCR. Chemistry of primer synthesis.

MODULE III - HYBRIDIZATION METHODS (9 Periods)

Probes – Labeling of probes- Radioactive and non-radioactive probes - Detection techniques, Southern hybridization, Northern hybridization, Western blotting.

MODULE IV - DNA SEQUENCING AND GENE SYNTHESIS (9 Periods)

Sanger's method of DNA sequencing – Manual and automated methods. Pyrosequencing – massively parallel 454-sequencing, Illumina sequencing, SOLiD sequencing, single molecule sequencing.

MODULE V - PROTEIN TECHNIQUES (9 Periods)

Electrophoresis of protein – native and denaturing conditions, capillary and gel electrophoresis, 2D gel electrophoresis, ELISA, yeast hybrid system – one hybrid system – two hybrid system, phage display.

TEXT BOOK

1. Joseph Sambrook, David William Russell "Molecular cloning". 3rd Edition, CSHL Press, 2001.

REFERENCES BOOKS

1. Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl, "Current Protocols in Molecular Biology", John Wiley& Son, Inc. 2003. 2. Daniel C. Liebler "Introduction to Proteomics", Humana Press, 2002.

COURSE OUTCOMES (COs)	
CO1	Understand the steps in Biopharmaceutical industries
CO2	Explain the features of Transformation and selection of recombinants
CO3	Characterization of recombinant proteins
CO4	Chromosome engineering, Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation
CO5	Role of Genetic Engineering in Forensic Medicine

CO6	Understand the steps in mutational studies

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H			M		H		M	H		H
	CO2		M								H		H
	CO3			M		M		M		H	H		H
	CO4		M					H		H	H		H
	CO5			M		M		M		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE304	MICROBIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Immunology, Clinical Pathology and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES .	1. To learn about the general concepts of Microbes. 2. To understand the properties of interactions between bacteria and Fungi. 3. To know about the microbial biochemistry and physiology				

MODULE I: INTRODUCTION TO MICROBIOLOGY (9 Periods)

Scope of Microbiology. Characterization, Classification and Identification of microorganisms, Microscopic examination of Microbes and their morphology. Fine structures of bacteria, cultivation of bacteria, reproduction & growth, pure cultures and cultural characteristics.

MODULE II: MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY (9 Periods)

Biochemistry of Microorganisms, Microbial metabolism, energy production, utilization of energy & biosynthesis, Bacterial genetics. Fungi – classification, importance, characteristics, morphology, reproduction, physiology cultivation, molds. Algae – importance of algae – characteristics of algae, classification of protozoans.

MODULE III: MICROBIAL GENETICS AND PATHOLOGY (9 Periods)

Organization of Genetic materials in Microorganisms. Microbial Genetics. Bacterial Genomics. Reproduction in microorganisms. Microbial proteomics. Pathophysiological aspects of Microorganisms.

MODULE IV: VIRUSES OF BACTERIA, ANIMAL AND PLANTS (9 Periods)

Viral Genomics, Virus infections in animals. Bacteriophages- General characteristics- Morphology and structure, Classification and Nomenclature - Bacteriophages of *E.coli*– Replication, viruses of plants - Structure- Replication- viruses in animals - Classification, isolation and identification-fatal diseases, Viroids.

MODULE V: ENVIRONMENTAL AND INDUSTRIAL MICROBIOLOGY

(9 Periods)

Microbiology of soil – aquatic microbiology, Microbiology of domestic water and waste water. Microbiology of fuel and Industrial microbiology.

TEXT BOOKS

1. Text of microbiology by Tortara, 10th edition
2. Microbiology by Pelczar, JR E.C.S Chan and noel R. Krieg. Fifth edition Tata McGraw Hill -2006

REFERENCE BOOKS

1. Microbiology – Harly and Prescott, 10th edition 2012
2. Microbiology by Sathyanarayana, 2010

COURSE OUTCOMES (COs)	
CO1	Outline the general concepts of pure culture and cultural characteristics.
CO2	Basic structures of microbes and its properties.
CO3	To know about microbial genetics and pathology.
CO4	Explain the concept of Structure and functions of Actinomycetes.
CO5	Illustrate the Basics of hospital acquired infections.
CO6	To describe the concept of fungal borne diseases.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H			M				M	H		H
	CO2		M								H		H
	CO3			M		M				H	H		H
	CO4		M			H				M	H		H
	CO5		H	M		M				H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

		L	T	P	C
U18PCGE305	**BASICS OF BIOCHEMISTRY**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Microbiology, Bio-organic chemistry				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES .	To be able to employ biochemical and Bio molecules, structure of water & its importance				

MODULE I: INTRODUCTION TO BIOCHEMISTRY (9 Periods)

Biomolecules, structure of water & its importance – Important noncovalent forces – Hydrogen bonds, electrostatic, hydrophobic & Vanderwaals forces – Acid, base & buffers – pH, Biological buffers and their significance – Principle of viscosity – surface tension, adsorption, diffusion, osmosis & their applications in biological systems.

MODULE II: STRUCTURE & PROPERTIES OF CARBOHYDRATES (9 Periods)

Classification and properties of Carbohydrates, Classification, and properties of amino acids & proteins. Classification, and properties of Lipids, Transport of lipids, Structure & functions of nucleic acids – Nucleosides , nucleotides – Cyclic AMP, cyclic GMP , ATP , GTP – DNA & RNA

MODULE III: CLASSIFICATION OF ENZYMES (9 Periods)

Chemical nature, Specificity of Enzyme catalyzed reactions, Enzyme Regulation- Feedback, Allosteric, Covalent modification, Hormonal regulation. Assay of enzymes, enzymes in clinical diagnosis of diseases. Introduction to Metabolism: Glycolysis, beta-oxidation, ketogenesis and cholesterol metabolism. TCA cycle: Structure of biological membranes, electron transport & Oxidative phosphorylation.

MODULE IV: HORMONES AS CHEMICAL MESSENGERS (9 Periods)

Liver function and their tests, Kidney function and its tests, constituents of urine and their clinical significance. General characteristics, structure, classification and function of hormones. Hormones as chemical messengers: General assay of hormones – Bio assay, chemical assay & immunoassays.

MODULE V: ANALYTICAL TECHNIQUES (9 Periods)

Principle, Types, and applications of electrophoresis, Isoelectric focusing, Two Dimensional Electrophoresis. Types of Chromatography and their significance, Spectro photometry, Fluorimetry, Flame photometry, Manometry, Microcalorimetry, Electrochemical methods, biosensors, use of radio isotopes in biochemistry.

TEXT BOOKS:

1. Harper's review of biochemistry By David.W. Martin, Peter. A. Mayes, Victor. W. Rodwell .LANGE medical publications.
2. Practical Biochemistry – Principles & Techniques by Keith Wilson & John Walker. Oxford University Press.

REFERENCE BOOKS:

1. Understanding Enzymes by Trevor palmer. Published by Ellis Horwood Ltd.
2. Biochemistry Lippincott's Illustrated Reviews by Pamela. C. Champe & Richard. A. Harvey. Lippincott-Raven Publishers.

COURSE OUTCOMES (COs)	
CO1	Understand Classification, structure & properties of carbohydrates
CO2	Identify synthetic strategies Classification of Enzymes, Chemical nature, Active Site, Specificity of Enzyme catalyzed reactions
CO3	Identify the role of enzymes in organic synthesis
CO4	Understand the Hormones as chemical messengers: General assay of hormones – Bio assay, chemical assay & immuno assays.
CO5	Explain importance and influence of metal ions on protein function
CO6	To describe the concept of bio molecules.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H			M	H		H	M	H	H	H
	CO2		M				H		H		H	H	H
	CO3			M		M	L		M	H	H	H	H
	CO4		M			H	M		H	M	H	H	H
	CO5		H	M		M	L		M	H	M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

		L	T	P	C
U18PCGE3L1	**MICROBIOLOGY LABORATORY**				
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Basic Microbiology techniques				
	Course Designed by – Department of Genetic Engineering				
OBJECTIVES	1. Understand explicitly the concepts of microorganisms 2. Develop their skills in the preparation, identification and quantification of microorganisms				

LIST OF EXPERIMENTS

1. Sterilization techniques
2. Media preparation
3. Preparation of nutrient broth
4. Preparation of nutrient agar media
5. Staining Techniques (Simple, Gram staining, spore staining)
6. Pure culture techniques (a) streak plate method (b) pour plate method (c) Spread plate method
7. Acid fast technique
8. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
9. Biochemical Characterization of Bacteria
    i) Oxidation/Fermentation Test
    ii) Catalase, Oxidase and Urease Tests
10. Lethal effect of bacteria
11. Motility test by hanging drop method

TEXT BOOKS

1. Microbiology Bio 204 Laboratory Manual
2. Laboratory Manual in general Microbiology (1916)
3. Microbiology Bio1 2421L Laboratory Manual (Donna Cain, Hershell Hanks, Mary Weis,
4. Carroll Bottoms, and Jonathan Lawson)
5. Basic Practical Microbiology (John Grainger)

http://www.biotopics.co.uk/microbes/tech1.html

COURSE OUTCOMES (COs)	
CO1	Understand and demonstrate the working principles, procedures of microbiology Lab experiments and equipments
CO2	To understand the concept of sterilization
CO3	Observe and practice different types of culture media and broth for microbial cultivation
CO4	To know about disinfection methods
CO5	Differentiate microbes using different staining methods
CO6	Estimate and evaluate the microbial screening, identification and characterization

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	M	H			M		H		M	H		H
	CO2		M					H			H		H
	CO3			M		M		H		H	H		H
	CO4		M			H		H		M	H		H
	CO5		H	M		M		H		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE3L2	BIOCHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Basic Biochemical Techniques				
	Course Designed by – Department of Genetic Engineering				

OBJECTIVES

1. Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.
2. Understand explicitly the concepts
3. Develop their skills in the preparation, qualitative and quantitative analysis.

LIST OF EXPERIMENTS

1. pH measurements and preparation of buffers.
2. Qualitative tests for Carbohydrates.
3. Estimation of sugars.
4. Estimation of proteins by Lowry's method / Biuret method.
5. Estimation of cholesterol by Zak's method.
6. Determination of saponification number of lipids.
7. Estimation of Amino acids.
8. Separation of amino acids - Thin layer chromatography.
9. Separation of sugars - Paper chromatography
10. Biochemical estimation of DNA /RNA using Spectrophotometer

TEXT BOOKS

1. Biochemistry Laboratory Manual - Mark Brandt, Ph.D. 3rd edition , 2002
2. Biochemistry Laboratory Manual – Dr. Dennis Welsh**,** 2013
3. Biochemistry Laboratory Manual Che 4350. Andrew J. Bonham, Ph. D, 2013
   https://www.liverpool.ac.uk/~agmclen/Medpracs/Prachomepage.html

COURSE OUTCOMES (COs)	
CO1	Determination of saponification number of lipids.
CO2	Estimation of Amino acids.
CO3	Separation of amino acids - Thin layer chromatography.
CO4	Separation of sugars - Paper chromatography
CO5	To detect proteins using Ramachandran Plot
CO6	Estimate and evaluate the Proteins and amino acids

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs/POs	A	b	c	d	e	f	G	h	i	j	k	l
CO1	M	H		H	M		H		M	H		H
CO2			H					H			H	H
CO3	H	H		H	M		H		H	H		H
CO4	H			M				M		H		H
CO5	L	H	M		H		H		H	M		M
Category	Professional core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE401	rDNA TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Cell biology, Genetics, and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various types of vector-host systems and steps in creating a recombinant DNA molecule				

MODULE I: MOLECULAR TOOLS FOR GENE CLONING (9 Periods)

Types of Restriction enzymes. DNA and RNA polymerases, reverse transcriptase, terminal transferase, DNA/RNA modifying enzymes- methylases- DNA ligase, RNA ligase. RNases, Nucleases – RNase free DNAse- T4 polynucleotide kinase. Phosphatases- Topoisomerase.

MODULE II: VECTORS FOR GENE CLONING (9 Periods)

Introduction to cloning vectors, plasmid vectors (high copy and low copy), phage vectors, cosmid vectors, phasmid vectors, BAC vectors and YAC vectors.

MODULE III: CLONING TECHNIQUES (9 Periods)

Cloning- blunt and cohesive end ligation – creation of restriction sites by PCR- linkers and adapters - homopolymer tailing. Strategies for cloning PCR products – TA cloning -TOPO-cloning-PCR product using SfrI restriction enzyme.

MODULE IV: CONSTRUCTION OF GENE LIBRARIES (9 Periods)

Construction of cDNA library- Construction subtractive cDNA library – Construction of genomic DNA library – BAC library – YAC library.

MODULE V: EXPRESSION OF RECOMBINANT PROTEIN IN E.COLI (9 Periods)

General features and promoters of Plasmid expression vectors- cloning of genes in expression vector- purification of recombinant protein using Histidine tag, GST tag, Chitin binding domain- codon usage databases- codon optimization in expression of recombinant protein.

TEXT BOOKS:

1. Principles of gene manipulation by Old and Primrose
2. Molecular Cloning – A Laboratory Manual by Sambrook and Russell

REFERENCE BOOKS

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. http://www.ncbi.nlm.nih.gov/books/NBK9950/

COURSE OUTCOMES (COs)	
CO1	Understand the steps in recombinant DNA/RNA modifying enzymes
CO2	Explain the features of various types of gene cloning vectors
CO3	Strategies for cloning PCR products
CO4	construction subtractive cDNA library
CO5	Plasmid expression vectors-general features, promoters used in expression vectors
CO6	To gain knowledge on various recombinant DNA techniques and their applications.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M	H	M	H
	CO2		M		M			H			H		H
	CO3			H		M			H			M	H
	CO4	L	M		L			H			H		H

	CO5	M	H	M		M		H		H	M	M	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE402	MOLECULAR BIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Recombinant DNA technology, Genetics and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To understand cellular organization, transport of molecules cell interactions and Signaling.				

MODULE I: - INTRODUCTION TO MOLECULAR BIOLOGY (9 Periods)

Scope and History, Structure of DNA-Nucleoside, Nucleotide, Features of Watson and Crick model, Super coiling- twist, writhe and linking number, Forms of DNA- A, B, Z. Structure and function of mRNA, rRNA, and tRNA.

MODULE II: REPLICATION AND REPAIR (9 Periods)

Types and functions of DNA polymerases in Prokaryote and Eukaryote, Replication in prokaryote and Eukaryote. Proof reading activity, 5'-3' exonuclease activity, topoisomerase activity, Telomeric DNA replication and Plasmid Replication models.

MODULE III: POST TRANSCRIPTIONAL MODIFICATIONS (9 Periods)

Fine structure of prokaryotic and eukaryotic gene, Structure and function of the promoters in mRNA, rRNA, tRNA genes. RNA polymerases in prokaryote and eukaryotes. Transcription of mRNA, rRNA, and tRNA genes in Prokaryote and Eukaryote.

MODULE IV: TRANSLATION AND POST TRANSLATIONAL PROCESSING (9 Periods)

Genetic code and Wobble hypothesis, Translation in prokaryote and eukaryote, Post translational Modifications, Principles of protein sorting and targeting into endoplasmic reticulum, mitochondria, chloroplast, and nucleus.

MODULE V: GENE REGULATION (9 Periods)

Principles of gene regulation- Transcriptional and post transcriptional gene regulation - activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers. Operon- lac operon, trp operon, ara operon and gal operon.

TEXT BOOKS:

1. S.S. Purohit "Cell and Molecular biology", 2008, Agrobios (India).
2. Harvey Ladish "Cell Biology" W.H. Freeman, 2007.
3. Molecular Biology of Gene - Watson
4. Molecular and Cellular Biology- Stefen Wolfe

REFERENCE BOOKS

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. Molecular biology of Gene, Fifth edition Author James D. Watson 2004Benjamine Cumin (Publisher)
4. http://www.web-books.com/MolBio/

COURSE OUTCOMES (COs)	
CO1	Scope and History. Structure of DNA-Nucleoside
CO2	Types and functions of DNA polymerases in Prokaryote and Eukaryote. Replication in prokaryote and Eukaryote.
CO3	Fine structure of prokaryotic and eukaryotic gene, structure and function of the promoters in mRNA, rRNA, tRNA genes
CO4	Genetic code and Wobble hypothesis. Translation in prokaryote and eukaryote
CO5	Understand the Principles of gene regulation- Transcriptional and post transcriptional gene regulation-activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers
CO6	To describe DNA replication, gene expression at transcriptional and translational level gene regulation and DNA repair mechanisms

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	F	g	h	i	j	k	l
2	CO1	M	H			M		H		M	H		H
	CO2		M		H			H	H		L	M	H
	CO3	H		M		M			M				H
	CO4		M		M	H		H		M		L	H
	CO5	L	H	M		M		H		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE403	GENOMICS AND PROTEOMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Molecular biology, Genetics, rDNA Technology, and Bioinformatics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To Coding, non-coding chromosomes. To Applications of Proteome analysis				

MODULE I: INTRODUCTION TO GENOMICS (9 Periods)

Organization and Structure of Genomes, Genome Size – Genome Structure in Viruses and microbes, Coding, Non-coding chromosomes and high order structures – Genomes relatedness.

MODULE II: PHYSICAL MAPPING TECHNIQUES (9 Periods)

Chromosomes Micro dissection, Chromosomal mapping techniques, Genome sequencing – Placing small fragments on map – STS assembly – Gap closure – Pooling strategies – Cytogenetic mapping techniques.

MODULE III: FUNCTIONAL GENOMICS (9 Periods)

Gene finding – Annotation – ORF and functional prediction – Subtractive DNA library, screening – DNA sequencing - Hybridization techniques – Differential display and representational difference analysis – SAGE – TOGA, Analysis of RNA expression.

MODULE IV: PROTEOMICS TECHNIQUES (9 Periods)

Proteome analysis – Bridging Genomics and Proteomics - Protein level estimation – Edman protein micro sequencing – Protein cleavage – 2D gel electrophoresis – Metabolic labeling - Pattern analysis – Mass spectrometry – Principles of MALDI-TOF .

MODULE V: PROTEIN PROFILING (9 Periods)

Protein-protein interaction –Protein Chips – Applications of Proteomics in drug discovery- Phage antibodies as tools – Proteomics in plant genetics and breeding.

TEXT BOOKS

1. Primrose, S.B. and Twyman, R.H., "Principles of Genome Analysis and Genomics", Blackwell Publishing Co., 2003.
2. Liebler, D.C., "Introduction to Proteomics", Humana Press, 2002.
3. Discovering Genomics, Proteomics, & Bioinformatics. Campbell & Heyer (2003) Pearson Education, ISBN: 0-8053-4722-4.
4. Bioinformatics, Methods of Biochemical Analysis Series Vol. 43, Baxevanis & Ouellette (2001) John Wiley & Sons, ISBN 0-471-38391-0
4. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press, ISBN: 0262.

REFERENCE BOOKS

1. Pennington, S.R. and Dunn, M.J., "Proteomics", BIOS Scientific Publishers, 2001. 2. Hunt, S.P., Livesey, R. and Livesey, F.J., "Functional Genomics: A Practical Approach" Oxford University Press, 2000.
3. Suhai S., "Genomics and Proteomics: Functional and Computational Aspects", Springer, 2000.
4. Cantor, C.R. and Smith, C.L., "Genomics: The Science and Technology Behind the Human Genome Project", Wiley and Sons, 1999.

5. http://www.sciencedirect.com/science/book/9781907568107

COURSE OUTCOMES (COs)	
CO1	To organization and structure of genomes, Genome Size
CO2	To Chromosomes Micro dissection and chromosomal mapping techniques.
CO3	To understand the Functional Genomics.
CO4	To understand the principle of Mass spectrometry
CO5	To Understand the Phosphoprotein analysis- Genomics Vs Proteomics.
CO6	To know the proteomics in drug discovery research.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H		H	M			H	M		H	H
	CO2		M		H	L		H				L	H
	CO3	H		M		M		L	H		H	M	H
	CO4		M		L	H		H		M		H	H
	CO5	H		M		M		H	M		M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE404	**BASICS OF BIOINFORMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biology, Enzyme Technology, and Basic computer Science				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To understand the significance of string alignment. To construct the phylogenetic tree.				

MODULE I: Introduction to Bioinformatics and Basics of Internet (9Periods)
Biology in the computer age - Introduction to Bioinformatics, Basics of computers - Servers, workstations, operating systems. Search Engines, Public Biological databases. Introduction to BIOSEQ's and types.

MODULE II: BIOLOGICAL DATABASES (9Periods)

Biological databases-Types and properties. Structure classification databases. Genome Information Resources: DNA sequence databases, specialized genomic resources, GRAIL, GENSCAN.

MODULE III: ALIGNMENT TECHNIQUES (9Periods)

Pair-wise Alignment Technique and searching: Global and local alignment, Multiple sequence Alignment databases and goals, Manual methods types, Secondary database searching and package analysis.

MODULE IV: PROTEIN ANALYSIS (9 Periods)

Protein Chips, Bioinformatics tools in proteomics - Protein identity based on composition, Motifs and patterns, secondary structure prediction, specialized secondary structures, tertiary structure.

MODULE V: INTRODUCTION TO PERL (9 Periods)

Using PERL to facilitate biological analysis, Strings, numbers, and variables, Basic input & output, File handles, Conditional Blocks & loops, Pattern matching, Arrays and Hashes.

TEXT BOOKS

1. Andreas D Baxevanis & B F Francis," Bioinformatics- A practical guide to analysis of Genes & Proteins", John Wiley, 2002.
2. T K Attwood, D J Parry-Smith," Introduction to Bioinformatics", Pearson Education.

REFERENCE BOOKS

1. Introduction to Bioinformatics, T. K. Attwood & D.J. Parry-Smith, Prentice Hall 2000.
2. Instant notes on Bioinformatics, D.R. West head.J.H. Parish R.M. Twyman, Liva Books, New Delhi, 2003
3. "Bioinformatics Sequence and Genome analysis", David W. Mount 2003.
4. "Bioinformatics Basics 'Applications in Biological science and Medicine" Hooman H. Rashidi &Lukas K. Buehie 2001.
5. Introduction to bioinformatics: A theoretical and practical approach by Stephen A wetz and David. D Woumble Publication: Humana Press. 2003
6. Sequence and Genome analysis. David W. Mount, 2004 Cold spring harbour laboratory press New York.

COURSE OUTCOMES (COs)	
CO1	Explain various types of network protocols and biological databases
CO2	Demonstrate and interpret the string matching and dynamic program algorithms of macromolecular strings
CO3	Apply, solve and interpret the heuristics based pair wise and multiple sequence analysis of macromolecules
CO4	Construct and interpret the molecular phylogenetic trees
CO5	Predict and understand the gene and protein structures, and microarrays
CO6	To understand the fundamentals of protein structure prediction and microarray analysis

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H		H	M			H	M		H	H
	CO2		M		H	L		H				L	H
	CO3	H		M		M		L	H		H	M	H
	CO4		M		L	H		H		M		H	H
	CO5	H		M		M		H	M		M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE405	PLANT TISSUE CULTURE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Recombinant DNA Technology				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. This course deals with engineering gene of interest to produce transgenic animals and plants for human welfare 2. To make the students to understand the basic concepts and applications of plant tissue culture. 3. To impart knowledge on production of transgenic plants and exploiting it as bioreactors. 4. To improve awareness on the applications of transgenic plants				

MODULE I: BASICS OF PLANT TISSUE CULTURE (9 Periods)

History of plant tissue culture- totipotency- Organizing a tissue culture lab-sterilization techniques- callus differentiation of cell and organs - clonal propagation- Regeneration and hardening-somatic clonal variation.

MODULE II: PREPARATION OF TISSUE CULTURE MEDIA (9 Periods)

Different media used for plant tissue culture-Composition of MS, Gamborg and White media-Use of hormones-Auxins- Cytokinins.

MODULE III: TISSUE CULTURE TECHNIQUES (9 Periods)

Callus culture- suspension culture -micropropagation-somatic embryogenesis- embryo culture –protoplast fusion- synthetic seeds - anther culture. Applications of tissue culture.

MODULE IV: PLANT TRANSFORMATION (9 Periods)

Agrobacterium – mechanism of T-DNA transfer -Ti plasmids derived vector system – biolistic gene transfer –reporter genes-GUS—marker genes-selectable and scorable markers-

constitutive and tissue specific promoters strategies for developing marker free transgenic plants-chloroplast transformation.

MODULE V: APPLICATIONS OF TRANSGENIC PLANTS (9 Periods)

Bt transgenics – virus resistant plants (coat protein, antisense RNA) – Glycophosate resistant transgenics – Genetic manipulation of flower pigmentation (Blue Rose) – Vitamin A and iron fortified rice – Plant-made antibodies and edible vaccines.

TEXT BOOKS

1. Molecular Biotechnology by Bernard R. Click and Jack. J. Pasternek
2. Plant Biotechnology by S. Ignacimuthu.
3. Text book of Plant tissue culture – Sathyanarayana

REFERENCE BOOKS

1. Introduction to Plant tissue culture – M.k. Razdan
2. Plant tissue culture – PR white
3. Plant propagation by plant tissue culture – EF George.

COURSE OUTCOMES (COs)	
CO1	Acquired the concept and basics of plant tissue culture.
CO2	Improved the experience in preparation of tissue culture media.
CO3	To know the working principles of tissue culture techniques.
CO4	understood the plant transformation methods and its uses
CO5	Improved idea about the applications in transgenic plants
CO6	Understood the competency methods.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE4L1	rDNA TECHNOLOGY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – rDNA Technology, Microbiology, and Cell Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To familiarize with cell counting and cell separation techniques.				

LIST OF EXPERIMENTS

1. Isolation of DNA from plant tissue
2. Isolation of DNA from animal tissue
3. Agarose gel electrophoresis
4. Effects of antibiotics by gradient method
5. UV induced mutagenesis
6. SDS page
7. Quantification of nucleic acids
8. Competent cell preparation
9. Transformation
10. Competent cell preparation
11. Polymerase Chain Reaction

TEXT BOOKS

1. Molecular biology laboratory manual - Hikmet Geckil.
2. Molecular Cloning – A Laboratory Manual by Sambrook and Russell.
4. https://www.inonu.edu.tr/Uploads/iys_dosyalar/1400/file/MBManual.pdf

COURSE OUTCOMES (COs)	
CO1	Demonstrate cell counting and cell separation techniques
CO2	Experiment to isolate DNA and RNA from various biological tissues.
CO3	Analyze and interpret DNA and RNA data.
CO4	Explain the activity of restriction enzymes and ligation of DNA.
CO5	Demonstrate bacterial genetics through conjugation experiment and Execute the effect of UV irradiation on bacterial genome
CO6	To gain hands on experience with action of restriction endonucleases and ligase on DNA

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H		M	M		H		M		H	H
	CO2		M				H		M		H		
	CO3	H		M	H	M		H		H		H	H
	CO4			H			H		H		H		
	CO5	M	H		H	M		H		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE4L2	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Biology, Genetics and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To give hands-on training in basic molecular biology techniques				

LIST OF EXPERIMENTS

1. DNA Extraction from plant using Agarose Gel Electrophoresis
2. Bacterial Transformation
3. Ligation technique
5. Design for PCR Oligonucleotide Handling
6. Polymerase Chain Reaction
7. Restriction Enzyme Digestion
8. Yeast (S. cerevisiae) Culturing
9. Plasmid DNA Isolation
10. RNA Extraction

REFERENCE:

1. Laboratory Investigations in Cell and Molecular Biology, Allen Bregman Wiley, 2001.
2. Laboratory manual for Cell biology - E. Eugene Williams
   http://www.public.asu.edu/

COURSE OUTCOMES (COs)	
CO1	To demonstrate cell counting and cell separation techniques
CO2	To experiment to isolate DNA and RNA from various biological tissues.
CO3	To analyze and interpret DNA and RNA data.
CO4	To explain the activity of restriction enzymes and ligation of DNA.
CO5	To demonstrate bacterial genetics through conjugation experiment and Execute the effect of UV irradiation on bacterial genome
CO6	To acquire practical skills related to DNA/ RNA isolation methods.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2		M		H		H		M				H
	CO3			M		M				H		M	H
	CO4	H			H		M		M		H		H
	CO5		H	M		M		H			M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE4L3	PLANT TISSUE CULTURE LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Plant Tissue Culture lab				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. Provides an opportunity to understand the basic practices of plant tissue culture. 2. It also helps in understanding the theoretical principles of producing transgenic plants in a more explicit and concentrated manner. 3. The students should be able to Understand explicitly the concepts. 4. To develop their skills in the plant tissue culture techniques				

LIST OF EXPERIMENTS

1. Preparation of Tissue Culture Media
2. Callus Induction, using rice embryo/endosperm culture

3. Transformation of Agro bacterium
4. Selection and sub-culture of algal species
5. Bacterial antibiotic sensitivity
6. Isolation of mutant clones by replica plate method – MSGEN208
7. Collection and culture of marine alga
8. Identification of bio-fertiliser activity using marine alga
9. GUS assay
10. Transgenic analysis by PCR

REFERENCE BOOK

1. Plant biotechnology Laboratory Manual (Dr. Lingaraj Sahoo).
2. Principles of Plant Genetics and Breeding - George Acquaah, 2007.

COURSE OUTCOMES (COs)	
CO1	Acquired the knowledge and experience on preparation of Tissue Culture Media.
CO2	Understood the callus induction, using rice embryo/endosperm culture and Transformation of Agrobacterium into plant
CO3	Selection and sub-culture of algal species
CO4	Bacterial antibiotic sensitivity and replica plate method
CO5	Transgene Analysis by PCR
CO6	Identification of Biofertilizer.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSMA501	BIOSTATISTICS	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Maths-I, Analytical techniques.				
	Course Designed by – Dept of Mathematics				
OBJECTIVES	To be able to employ for numerical problems				

MODULE I: INTRODUCTION TO BIO-STATISTICS (numerical problems only) (12 Periods)

Introduction and Basics of Bio Statistics. Applications of Biostatistics. Handling univariate and bi-variate data – Measures of central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression.

MODULE II: PROBABILITY & THEORETICAL DISTRIBUTIONS (12 Periods)

Probability concepts – Conditional probability – Baye's theorem – one – dimensional random variables –expectation, variance, moments. Theoretical distributions: Binomial, Poisson, Normal (Problems only).

MODULE III: TESTING OF HYPOTHESIS (12 Periods)

Introduction – Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportions, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, Independence of attributes.

MODULE IV: ANALYSIS OF VARIANCE (12 Periods)

Small sample tests based on T and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances. ANOVA– One way classification, Two-way classification.

MODULE V: STATISTICAL QUALITY CONTROL (12 Periods)

Introduction – Process control – control charts for variables - X and R, X and s charts control charts for attributes: P chart, NP chart, C chart.

TEXT BOOKS

1. S.C. Gupta &V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2003.
2. Kapur J.N. And Saxena H. C. 'Mathematical Statistics". S. Chand and Co., New Delhi 2004.
3. Veerarajan T. "Probability Statistics and Random Process" Tata McGraw Hill, New Delhi 2003.
4. S.C. Gupta and V.K. Kapoor, "Applied Statistics". S. Chand and Sons, New Delhi 2004.

REFERENCE BOOKS:

1. Biostatistics, second edition: A Guide to Design, Analysis and Discovery by Ronals N. Forthofer, fun sel lee, and Mike Hemandez (Hardcover-Dec 28, 2006)
2. Biostatistics: Principles and Practice by B. Antonisamy Solomom Christopher, Prasanna Samuelson 1st edition Pub Date 14 Sep 09.
3. PN.Arora and S. Arora, 'Statistics for Management", S.Chand and sons, New Delhi 2003
4. http://www.dcscience.net/Lectures_on_biostatistics-ocr4.pdf

COURSE OUTCOMES (COs)	
CO1	To Biostatistics and Basics of Bio Statistics. Applications of Biostatistics
CO2	Identify synthetic strategies Probability concepts – conditional probability – Baye's theorem
CO3	Introduction – Large sample tests based on normal distribution
CO4	Understand the ANOVA– one –way classification, Two-way classification.
CO5	Understand the Statistical Quality Control.
CO6	To identify numerical methods

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M				M		H		M	H		M
	CO2		M		H		H	H				H	
	CO3	H		M		M				H			H
	CO4			H			H		H	M		M	H
	CO5	H	H		H	M		H		H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

	IMMUNOLOGY	L	T	P	C
U18PCGE501	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Recombinant DNA technology, Principles of Genetics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	1. To learn about the general concepts of immune system and immune organs 2.To understand the properties of antigens and antibodies and the concept of antigen-antibody interactions 3.To know about the mechanisms related to cell mediated immunity, complement system, Hypersensitivity and transplantation immunology.				

MODULE I: OVERVIEW OF THE IMMUNE SYSTEM (9 Periods)

Types of Immune responses. Innate Immunity, adaptive immunity, Cellular immunity, comparative immunity cells and organs of the immune system, Antigens - HLA antigens, MHC antigens.

MODULE II: IMMUNOGLOBULIN STRUCTURE AND FUNCTIONS (9 Periods)

Basic structures of Immunoglobulin's – Immunoglobulin classes and biological activities, Antigenic determinants on Ig, Plasma cells and B cell receptors, Monoclonal antibodies – cytokines – complement system.

MODULE III: ANTIGEN – ANTIBODY INTERACTIONS (9 Periods)

Antibody Affinity and activity – Antibody specificity - Precipitation reactions- agglutination reactions, MHC Antigen processing & presentations, Immunological network, Immunological techniques, Radio immunoassay- ELISA Western blotting, Immunoprecipitation, Immunofluroscence, Flow cytometers

MODULE IV: T & B CELL MATURATION, ACTIVATION & DIFFERENTIATION (9 Periods)

Structure and functions of T and B lymphocytes, Bone marrow and Hematopoietic stem cells. T cell receptor, T Cell maturation, Dendritic cells, Lymphocyte activation and differentiation of B cells - activation and differentiation of cell mediated immune responses.

MODULE V: IMMUNE SYSTEM IN HEALTH & DISEASE (9 Periods)

Basics of Immune disorders and inflammation, hypersensitive reactions, immune responses to infectious diseases, vaccines. Cancer immunology. Immunoinformatics, Clinical Immunology, Immunological databases.

TEXT BOOKS:

1. Kuby, Immunology by Richard A. Golds by Tharmas J. kindt fourth edition, 2000 and Barbara Osborne. W.H.Freeman and company
2. Text of Microbiology – Tortora, 10th edition

REFERENCE BOOKS

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I, Brostoff J. and Male D. Immunology, 6thed. Mosby, 2001
3. Goldsby R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H.Freeman, 2003

4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997
https://www.immunology.org/

COURSE OUTCOMES (COs)	
CO1	Outline the general concepts of immune system and describe the cells and organs of the immune system
CO2	To understand molecular techniques of immunogens
CO3	Basic structures of Immunoglobulins – Ig classes and biological activities,
CO4	Antibody Affinity and activity – Antibody specificity - Precipitation reactions
CO5	Explain the concept of Structure and functions of T and B lymphocytes
CO6	Illustrate the Basics of Immune disorders and inflammation.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M				M	H		H
	CO2		M								H		H
	CO3			M		M				H	H		H
	CO4		M			H				M	H		H
	CO5		H	M		M				H	M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE502	**GENES AND DISEASES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Gene therapy, Bio-Pharmaceutical technology				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	To understand the genes that control or influence the heritable human diseases 1. To understand the pattern of inheritance of heritable diseases 2. To learn about the genetics of most prevalent cancers in India 3. To learn about the genetics of metabolic disorders and disease of nervous system 4. To learn about the genetics of ear, eye and blood disorders				

MODULE I: INTRODUCTION TO DEFECTIVE GENES (9 Periods)

Introduction to the diseases, Mechanism of Genetic Diseases, Types of Mutations. Dominance, recessive, co-dominance, autosomal and sex linked inheritance of diseases. Chromosomal maps.

MODULE II: GENETIC DISORDERS (9 Periods)

Single Gene disorders, X-linked recessive, Y-linked and Mitochondrial disorders. Multifactorial and polygenic disorders. FIND base. Genetic epidemiology. Inborn errors of metabolism. Population groups in biomedicine.

MODULE III: GENETIC TESTING (9 Periods)

Genetic Testing, Genetic diseases prevention, Genetic counseling. Pharmacogenomics. Public Health Genomics in Information centres. Human Genome Project.

MODULE IV: GENETIC DISEASES (9 Periods)

Genetic diseases of Blood and lymph, digestive system, ear, nose and throat. Diseases of the eye, glands and hormones. Diseases of heart and blood vessels. diseases of the immune system, and muscle and bone.

MODULE V: GENETIC DISORDERS (9 Periods)

Congenital and Neonatal diseases, Diseases of the nervous and Respiratory system, nutritional and metabolic diseases. diseases of skin and connective tissue. Prognosis and treatment of genetic disorders

TEXT BOOKS

1. Genes and Diseases, NCBI Bookself, free e-book.
2. The principles of gene manipulation (Primrose – sixth edition).

REFERENCE BOOKS

1. Genes, Benjamin and Lewin, 8th edition. Pearson Prentice Hall, 2004
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss, 2003.
3. Human Genetics and Genomics, Third Edition - Bruce R. Korf
4. Human Genetics: Principles and Approaches - Friedrich Vogel and Arno G. Motulsky
5. http://www.ncbi.nlm.nih.gov/books/bookres.fcgi/gnd/tocstatic.html

COURSE OUTCOMES (COs)	
CO1	Mechanism of Genetic Diseases.
CO2	Genetics of metabolic disorders
CO3	Genetics of the diseases of nervous system
CO4	Genetics of ear, eye and blood disorders
CO5	Congenital disorders and Neonatal diseases
CO6	Treatment of genetic disorders.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE42	VIROLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Microbiology, Cell biology and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs				

MODULE I: CULTIVATION OF VIRUSES (9 Periods)

Cultivation of plant, animal and bacterial virus, growth curve, methods for purification of viruses, plaque assay, generation of transformed cell foci.

MODULE II: REPLICATION CYCLE (9 Periods)

Entry of enveloped and non-enveloped animal and plant virus. Bacteriophage; replication and expression of viral genome, bacteriophages- lytic and lysogenic cycle and its regulation; late events of viral infection.

MODULE III: PATHOGENESIS OF VIRAL INFECTION (9 Periods)

Modes of virus spread; multiplication and occurrence of disease; immune response. Fate of the host; pathogenesis of hepatitis, HIV, EBV and influenza virus.

MODULE IV: PREVENTION AND TREATMENT OF VIRAL INFECTION (9 Periods)

Vaccination strategy; chemotherapy of viral diseases; interferon-its induction and action. Virus as therapeutic agent; viruses for gene therapy

MODULE V - PRIONS AND VIROIDS (9 Periods)

General properties; hypothesis of prion generation; disease caused by prions and viroids. Viruses-promise and problems: Source and causes of emergent virus diseases

Text books:

1. Culture of Animal Cells: A Manual of Basic Technique. R. Ian Freshney. Latest edition / Pub. Date: September 2005. Wiley.
2. Culture of Cells for Tissue Engineering. R. Ian Freshney. Pub.Date: March 2006. Wiley.
3. Invertebrate Tissue Culture Methods. Jun Mitsuhashi. Latest edition /Pub. Date: February 2002. Publisher: Springer-Verlag New York, LLC.

Reference books:

1. Essential Cell Biology. Bruce Alberts, Dennis Bray, Keith Roberts, Julian Lewis, Martin Raff. latest edition/Pub. Date: October 2003. Publisher: Taylor & Francis, Inc.
2. Molecular Cell Biology. Harvey Lodish, James Darnell, Paul Matsudaira, Arnold Berk, S. Lawrence Zipursky. Latest edition/Pub. Date: August 2003. Publisher: W. H. Freeman Company.
3. www.virology.net/Big_Virology/BVHomePage.html

COURSE OUTCOMES (COs)	
CO1	Understand the bulk production of commercially important products of viral culture.
CO2	Explain the method of introducing viral genomes into the cells
CO3	Strategies for microbial metabolites from industries.
CO4	Understand the pathogenesis of viral infection
CO5	To know the viral vectors-general features, promoters used in expression vectors
CO6	To gain knowledge on **p**revention and treatment of viral infection**.**

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	I	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE5L1	IMMUNOLOGY LABORATORY	L	T	P	C
	Total Contact Hours - 30	0	0	3	1.5
	Prerequisite – Cell Biology lab				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. The students should be able to develop their skills. 2. Provides an opportunity to experimentally verify the theoretical concepts already studied. 3. It also helps in understanding the theoretical principles in a more explicit and concentrated manner. 4. Explore the antigen and antibody reaction methods.				

LIST OF EXPERIMENTS

1. Blood grouping
2. Leukocyte count
3. PBMC preparation and their enumeration
4. Production of polyclonal antibodies – preparation of antigen – protocol for immunization in rabbits /mice
5. Antigen-antibody reaction- Haemagglutination, precipitation- Widal and VDRL
6. Immunodiffusion, Immunoelectrophoresis.
7. Affinity chromatography for antibody purification.
8. ELISA-DOT and plate ELISA
9. Immuno Blotting techniques
10. Agglutination reactions (a) direct (b) indirect

REFERENCE BOOK

1. Immunology Laboratory methods manual, 2009
2. Cell biology and immunology manual, Dr. Bea Holton

COURSE OUTCOMES (COs)	
CO1	Understood the blood grouping and types of blood groups.
CO2	Experienced in leucocytes count and PBMC preparation and their enumeration.
CO3	Production of polyclonal antibodies using immunization.
CO4	Antigen and Antibody reaction - types.
CO5	Blotting Techniques and ELISA types.
CO6	Antibody production

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE5L2	PROTEIN BIOCHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours - 30	0	0	3	1.5
	Prerequisite – Biochemistry lab				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. The students should be able to develop their skills. 2. Provides an opportunity to experimentally verify the theoretical concepts already studied. 3. It also helps in understanding the theoretical principles in a more explicit and concentrated manner. 4. Explore the antigen and antibody reaction methods.				

LIST OF EXPERIMENTS

1. Introduction to general techniques
2. Spectroscopy and Calorimetry.
3. Protein estimation
4. Chromatographic techniques
5. Gel electrophoresis
6. Protein Purification techniques
7. PCR
8. Identification methods of proteins
9. Western blotting
10. GC-MS

REFERENCE BOOK

1. Biochemistry Laboratory Manual - Mark Brandt, Ph.D. 3rd edition, 2002.
2. McPherson RA. Specific proteins. In: Clinical diagnosis and management, Henry JB, ed. Philadelphia: W. B. Saunders, 1984; 204–14.

COURSE OUTCOMES (COs)	
CO1	Understood the blood grouping and types of blood groups.
CO2	Experienced in leucocytes count and PBMC preparation and their enumeration.
CO3	Production of polyclonal antibodies using immunization.
CO4	Antigen and Antibody reaction - types.
CO5	Blotting Techniques and ELISA types.
CO6	Antibody production

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE5L3	GENOMICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Genetics and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To give hands-on training in basic molecular biology techniques				

LIST OF EXPERIMENTS

1. Isolation of RNA
2. Formaldehyde agarose gel electrophoresis of RNA
3. RNA quantification
4. cDNA synthesis
5. Reverse transcription PCR
6. Digital PCR
7. Transformation of E.coli with expression vector

8. Time course study of induction of gene expression with IPTG
9. SDS-PAGE
10. Northern Blotting

REFERENCE:

1. Laboratory Investigations in Genomics laboratory, Allen Bregman Wiley, 2007.
2. Laboratory manual for Molecular Biology - E. Eugene Williams, 2016

COURSE OUTCOMES (COs)	
CO1	To demonstrate cell counting and cell separation techniques
CO2	To experiment to isolate DNA and RNA from various biological tissues.
CO3	To analyze and interpret DNA and RNA data.
CO4	To explain the activity of restriction enzymes and ligation of DNA.
CO5	To demonstrate bacterial genetics through conjugation experiment and Execute the effect of UV irradiation on bacterial genome
CO6	To acquire practical skills related to DNA/ RNA isolation methods.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2		M		H		H		M				H
	CO3			M		M				H		M	H
	CO4	H			H		M		M		H		H
	CO5		H	M		M		H			M		M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE601	**RESEARCH METHODOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biophysics				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. Early entry graduate-level survey of research methods with an emphasis on comprehension of the educational research literature.				

	2. Course includes scientific method, locating. 3. Summarizing published research, sampling, measurement, statistics. 4. Increase the knowledge on research design, and critique of published research

MODULE I: INTRODUCTION TO RESEARCH (9 Periods)

Introduction and Types of Research – Various Steps in Research process, Mathematical tools for analysis, research question and problem, Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.

MODULE II: APPLICATIONS OF PROBABILITY DISTRIBUTIONS (9 Periods)

Quantitative Methods for problem solving: Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

MODULE III: FREQUENCY DISTRIBUTIONS (9 Periods)

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis

MODULE IV: NEURAL NETWORK ANALYSIS (9 Periods)

Soft Computing: Computer and its role in research, Use of statistical soft ware SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

MODULE V: RESEARCH REPORT ANALYSIS (9 Periods)

Structure and components of research report, Types of report, Layout of research report, Mechanism of writing a research report, referencing in academic writing.

TEXT BOOKS

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H. Mc Burney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047- 0,2006

REFERENCE BOOKS

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engineering Applications, Timothy J.Ross, Wiley Publications, 2nd Ed
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van
Laarhoven & E.H. Aarts
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg.
5.https://docs.google.com/viewer?a=v&pid=forums&srcid=MTAxNDI0NTM4NjczMzU3MTYzMTIBMTQyOTU2MzI2MDIwMDM2MTc5NDQBSm05QUZ1UENMOFVKATAuMQEBdjI

COURSE OUTCOMES (COs)	
CO1	Basic descriptive statistics including measures of central tendency, dispersion, and relationships.
CO2	Basic measurement concepts including validity and reliability and the role of measurement in inquiry.
CO3	Common and differentiating features of basic, applied, and evaluation research
CO4	Common and differentiating features of typical research designs (e.g. quantitative vs. qualitative, experimental vs. non-experimental, group vs. single-case).
CO5	Quality indicators in published research.
CO6	To Understand the research and development.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2		M		H		H		M		H		H
	CO3			M		M				H		M	H
	CO4	H			H		M		M		H	M	H
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE602	MOLECULAR EVOLUTION AND PHYLOGENY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – rDNA Technology, Microbiology, and Cell Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To familiarize with cell counting and cell separation techniques.				

MODULE I: INTRODUCTION (9 Periods)

Introduction in molecular evolution- Archaeology of the genome-Nature of molecular evolution - driving forces in evolution.

MODULE II: INTRODUCTION TO PHYLOGENETICS (9 Periods)

Fundamental elements of phylogenetic models-Identifying Orthologs and Paralogs-Trees and distances-Molecular Phylogenetic models-Universal phylogeny.

MODULE III: EVOLUTIONARY CHANGE (9 Periods)

Measuring genetic change - Genetic distance- Substitution models-Tree building methods-Distance based methods-Character based methods-Tree evaluation-Randomized trees Bootstrap-Phylogenetic softwares.

MODULE IV: MODELS OF MOLECULAR EVOLUTION (9 Periods)

Models of evolutionary process - Functional constraints - Molecular clocks, Evaluation of molecular clock hypothesis-Neutral theory.

MODULE V: PHYLOGENETIC APPLICATIONS (9 Periods)

Applications of molecular phylogenetics - Gene and Species trees, Organism phylogeny-Age and rates of diversification - Host parasite co-specification.

TEXT BOOK:

1."Evolution and population genetics" by Rashma sisodia 2006 (pg no.175 - 297)

REFERENCE:

1. Fundamentals of Molecular evolution", Dan Graur and Wen-Hsiung Li, Iled, 2000, Sinauer associates.

2. Molecular evolution: A Phylogenetic approach", Roderic D. M. Page, Edward C. Holmes Blackwell science Inc 2003. (pg no 1-172)(280-312).

www.ncbi.nlm.nih.gov/pubmed/1784710

https://www.biomedcentral.com/

COURSE OUTCOMES (COs)	
CO1	To learn about Nature of molecular evolution -driving forces in evolution
CO2	It also gives knowledge on Phylogenetic models-Universal phylogeny
CO3	It deals with protein truncation
CO4	It imparts determination of splicing variants
CO5	It impliments of the genetic variation
CO6	It gives the Knowledge about the Neutral theory

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M

	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE603	CYTOGENETICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Cell Biology, Cytology				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. Early entry graduate-level survey of research methods with an emphasis on comprehension of the educational research literature. 2. Course includes scientific method, locating. 3. Summarizing published research, sampling, measurement, statistics. 4. Increase the knowledge on research design, and critique of published research.				

MODULE I: MENDELIAN GENETICS (9 Periods)

Genetic inheritance, Mendelian Genetics, Mendel's experiments, principles of segregation, monohybrid cross – Independent Assortment, Gene interaction, multiple alleles.

MODULE II: CHROMOSOME STRUCTURE AND ORGANIZATION (9 Periods)

Chromosome structure and organization in prokaryotes and eukaryotes, Giant chromosomes, polythene and lampbrush, Sex determination and sex linkage, techniques in cytogenetic.

MODULE III: LINKAGE AND CROSSING OVER (9 Periods)

Linkage, Crossing over, cytological basis of crossing over, chromosome mapping, two and three factor cross, interference, somatic cell hybridization.

MODULE IV: VARIATION IN CHROMOSOME STRUCTURE AND NUMBER (9 Periods)

Deficiencies, duplication, inversion, translocation, positive effects, chromosomal aberration - classification of mutation, classification of ploidy, variation in chromosome number, extra chromosomal inheritance.

MODULE V: RECOMBINATION IN BACTERIA (9 Periods)

Bacterial Genomics, Transformation, Transduction, Conjugation – mapping, plasmids and episomes.

TEXT BOOKS

1. Principles of Genetics by Gardner, Simmons, Snustad, 8th edition – John Wiley and Sons, Inc., 2003.
2. The Cell: A molecular approach by Geoffrey M. Cooper. ASM Press, Pages: 673.

REFERENCE BOOKS

1. Molecular Cell Biology, Sixth Edition., by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira

Bioenergetics at a Glance: An Illustrated Introduction D. A. Harris, 1995 John Wiley & Sons Publishers, Inc
2. Biology of Microorganisms – Michael T. Madigan

COURSE OUTCOMES (COs)	
CO1	Basic descriptive statistics including measures of central tendency, dispersion, and relationships.
CO2	Basic measurement concepts including validity and reliability and the role of measurement in inquiry.
CO3	Common and differentiating features of basic, applied, and evaluation research
CO4	Common and differentiating features of typical research designs (e.g. quantitative vs. qualitative, experimental vs. non-experimental, group vs. single-case).
CO5	Quality indicators in published research.
CO6	To Understand the research and development.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE6L1	**GENE CLONING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	3	1.5
	Prerequisite – Molecular Biology laboratory				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1.The practical deals with creating recombinant DNA molecules 2.To give hands-on training in creating recombinant DNA molecules 3. Molecular analysis indirectly by restriction digestion and PCR as well as directly by DNA sequencing. 4. To give hands-on training Ligation and transformation				

LIST OF EXPERIMENTS

1. Isolation of total DNA.
2. Isolation of plasmid DNA.
3. Microbial cultures
4. Digestion and gel elution of vector and inserts
5. Ligation and transformation
6. Verification of cloning by colony PCR and patching the positive colonies
7. Plasmid isolation from PCR positive colonies
8. Confirmation of cloning by restriction digestion
9. Set up DNA sequencing reaction
10. Cleaning the sequencing reaction product

REFERENCE BOOK

1. Molecular Cloning - A Laboratory Manual. 4th ed, 2012 - Cold Spring Harbor Laboratory Press.
2. Molecular Biology I Biochemistry Level II: Practical Manual. Dr Peter Kille.
3. Molecular cloning – A laboratory manual. Joseph sambrook and David w. Russell
4. http://www.mclab.com/

COURSE OUTCOMES (COs)	
CO1	The studentcan able to isolate total DNA, Plant DNA and plasmid DNA.
CO2	The studentcan able to do molecular digestion and gel elution of vector and inserts and Ligation and transformation.
CO3	The studentcan able to do plasmid isolation from PCR positive colonies
CO4	The studentcan able to do Confirmation of cloning by restriction digestion
CO5	The studentcan able to do Ligation and transformation
CO6	Sequencing product

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE6L2	BIOINFORMATICS LABORATORY	L	T	P	C
	Total Contact Hours - 30	0	0	3	1.5
	Prerequisite – Molecular modeling laboratory				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1.To know about databases and their use 2. To understand sequence alignment and programming 3. To analyze the protein sequence using bioinformatics tools 4. To understand the use of PERL, Python in programming and executing research				

LIST OF EXPERIMENTS

1. Knowledge of different biological database
2. Sequence retrieval from biological database
3. Identification of protein sequence
4. Sequence similarity searching of protein sequences
5. Variants of Blast
6. Multiple sequence alignment
7. Dynamic programming method- local alignment
8. Dynamic programming method- global alignment
9. Pattern finding in proteins
10. Phylogenetic analysis with Clustal W and Blast software

REFERENCE BOOK

1. “Introduction to Bioinformatics”, T.K. Attwood & D.J.Parry-Smith, Prentice Hall 2000.
2.”Instant notes on Bioinformatics”, D.R. West head. J.H.Parish R.M. Twyman, Lviva Books, New Delhi, 2003
3. “Bioinformatics Sequence and Genome analysis”, David W. Mount 2003.
4. “Bioinformatics Basics 'Applications in Biological science and Medicine” Hooman H. Rashidi & Lukas K. Buehie 2001.
5. https://www.amc.nl

COURSE OUTCOMES (COs)	
CO1	The student can able to perform Sequence retrieval from biological database
CO2	The student can able to perform Identification of protein sequence
CO3	The student can able to perform Sequence similarity searching of protein sequences
CO4	The student can able to perform dynamic programming method- global and local alignment
CO5	The student can able to perform Phylogenetic analysis with Clustal W and Blast software
CO6	Phylogenetic analysis.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE701	ANIMAL CELL CULTURE AND TRANSGENIC TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Transgenic technology, animal science, techniques				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES:	To enable understanding chemical principles governing biochemical reactions				

MODULE I: BIOLOGY OF CULTURED ANIMAL CELLS (9 Periods)

Introduction to cell culture and uses, Cell types, - Cell growth in culture media -Importance of Culture media & culture conditions-Maintenance and storage of cell cultures- Biosafety and biohazards.

MODULE II: PRESERVATION AND CHARACTERIZATION OF CELL LINES (9 Periods)

Primary culture, subculture, and cell lines- Cloning and selection- Cell separation , characterization and Cell differentiation -Transformation and Immortalization- Contamination- Cryopreservation techniques.

MODULE III: SCALING UP OF ANIMAL CELL CULTURE (9 Periods)

Cell quantification methods-Cell viability measurements-Growth kinetics-Scale up of suspension & monolayer cultures-Air lift bioreactors.

MODULE IV: PRODUCTION OF TRANSGENIC ANIMALS (9 Periods)

Production methods of transgenic animals – Retroviral vector method – DNA micro injection – Engineered embryonic stem cell method, Oocyte culture, Transgenic animals and Birds.

MODULE V: **APPLICATIONS OF ANIMAL CELL CULTURE (9 Periods)**

Animal cells as bioreactors – therapeutic proteins – Enzymes – Vaccines– applications of transgenic animals in recombinant proteins, better nutrition, bioindicators.

TEXT BOOKS

1. Culture of Animal cells by R.I. Freshney, Fifth edition
2. Culturing of Animal cells. Biotol publications
3. Molecular Biotechnology by Bernard R. Click and Jack. J. Pasternek

REFERENCE BOOKS

1. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 1998
2. Freshney R.I. Animal Cell Culture- a practical approach, 1987
3. Bernhard Palsson and Sangeetha N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.
4. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Springer, 2008.
5. biology.tutorvista.com/organism/animal-tissue.html
6. www.ivyroses.com/HumanBody/**Tissue**/**Tissue**_4-**Tissue**-Types.php

COURSE OUTCOMES (COs)	
CO1	Understand Importance of aseptic techniques
CO2	Preservation And Characterization Of Cell Lines.
CO3	Understand the Cell quantification
CO4	Understand the Methodology of production of transgenic animals.
CO5	understand the the production of recombinant proteins
CO6	Principles and advanced methods of animal cell culture techniques

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE7L1	ANIMAL CELL CULTURE LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	2	1
	Prerequisite – animal Cell Culture, anti cancer agent in cell culture				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES:	To enable understanding chemical principles governing biochemical reactions.				

LIST OF EXPERIMENTS

1. Preparation of culture media
2. Sterilization techniques of cell and tissue culture labwares/Glasswares
3. Adaptation of Animal virus in cell lines.
4. Study of effect of anti cancer agent in cell culture.
5. Organ Culture
5. MTT Assay
6. Live cell counting
7. Leukocyte culture
8. Culturing of spleen cells
9. PBMC or Myeloma cell culture
10. Fusion of cells by PEG

REFERENCE BOOK

1. Basics of Cell Culture - A student laboratory manual By Golnar Afshar PhD Laboratory Manual
2. Introduction to animal Cell Culture, John A Ryan
3. www.anl.gov/safety/biosafety/biosafety-**links**
4. www.bio-**link**.org/home/sites/files/instructor_manualv8.pdf

COURSE OUTCOMES (COs)	
CO1	Preparation of culture media
CO2	Sterilization techniques of cell and tissue culture labwares/Glasswares
CO3	Adaptation of Animal virus in cell lines.
CO4	Study of effect of anti cancer agent in cell culture.
CO5	Preparation of culture media
CO6	Sterilization techniques of cell and tissue culture labwares/Glasswares

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M		M		L		
	CO5		H	M		M		H			M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

ELECTIVES

U18PEGE011	HUMAN GENETICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Principles of Genetics, Microbiology				
	Course Designed by – Department of Genetic Engineering				
OBJECTIVES	1. To understand fundamental laws of genetics. 2. To know techniques in *in situ* genetic analysis for mutation and aberration studies. 3. To identify and relate phenotype to changes in chromosome structure and number.				

MODULE I: GENOME ORGANIZATION AND INHERITANCE (9 Periods)

Organization of genomes, Types of Inheritance- Factors affecting Inheritance and Patterns- Consanguinity in Human Populations, X inactivation- Sex-Linked and Mitochondrial Inheritance.

MODULE II: GENOME MAPPING AND DEVELOPMENTAL GENETICS (9 Periods)

Physical Mapping, Genetic mapping- Two-point mapping, Multipoint mapping, parametric and Nonparametric linkage analysis, Development genetics - Molecular Toolbox- Pattern Formation.

MODULE III: MEDICAL GENETICS (9 Periods)

Chromosomal Basis of Human Disease- Nomenclature-Abnormalities of Chromosome Number and Structure- Cancer genetics- Activation of proto-oncogenes, Tumor suppressor genes, Pharmacogenetics.

MODULE IV: IDENTIFICATION OF DISEASE GENES (9 Periods)

Principles and strategies in identifying disease genes, positional cloning, Positional candidate strategy, its map position and expression, function or homology, confirming a candidate gene.

MODULE V: THE GENETICS OF COMMON DISEASES (9 Periods)

Genetic Screening and Diagnosis, Population Screening for Genetic Diseases, Prenatal Diagnosis of Genetic Disorders and Congenital Defects, Fetal Treatment, Pedigree analysis and Genetic Counseling.

TEXT BOOKS

1. Human Molecular Genetics – Tom Strachan and Andrew P. Read
2. Medical Genetics 3rd Edition- Jorde, Carey, Bamshad& White.

REFERENCE BOOKS

1. Human Genetics and Genomics, Third Edition - Bruce R. Korf
2. Human Genetics: Principles and Approaches - Friedrich Vogel and Arno G. Motulsky
3. Watson, J.D., Gilman, M., Witowski J.and Zoller, M. Recombinant DNA, 2nd ed., Scientific American Books, 1983
4. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1684911/

COURSE OUTCOMES (COs)	
CO1	This course introduces the principles of genetics.
CO2	It discusses the basics laws of inheritance.
CO3	It gives chromosome structure and cytological techniques.
CO4	Properties of chromosome variation, linkage mapping and population genetics.
CO5	To understand the linkage analysis and recombination mapping.
CO6	To study population genetics and analyze quantitative characters.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE12	ANIMAL TISSUE ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Microbiology, Animal biotechnology, Tissue Engineering, Cell biology and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To make understand of the animal tissue culture engineering so as to help them to manipulate the cell to the requirement of the grafting needs				

MODULE I: **INTRODUCTION TO SEROLOGY** **(9 Periods)**

Biology of cells in culture, Origin and characterization of different cell types, Subculture, selection of medium, Development of serum free media, Composition and advantages of serum free media.

MODULE II: STERILIZATION AND DISINFECTION **(9 Periods)**

Aseptic techniques, Media preparation, Cell counting methods, Growth of adherent and suspension cultures, Measurement of growth parameters of cultured cells, Maintenance and cryopreservation of cell lines, Mycoplasma and virus testing, Cell transfection.

MODULE III: ANIMAL CELL CULTURE **(9 Periods)**

Animal handling techniques and care, Cell line preparation, Mass cell cultivation, Mouse embryo fibroblast culture, staining techniques for animal cells, preparation of mice splenocytes, culture and adaptation of virus in chick embryo culture.

MODULE IV: HYBRIDOMA TECHNOLOGY **(9 Periods)**

Hybridomas and cell transformation technology, Storage of hybridoma cells, Monoclonal antibodies and their commercial production and their use for mankind.

MODULE V: MAMMALIAN CELL CULTURE **(9 Periods)**

Gene transfer techniques in mammalian cells, Embryo fertilisation, Somatic cell nuclear transfer and transgenic animals, Characteristics of cancer cell growth in culture and senescence.

Text Books:

1. Campbell, N. A. and Jane B. Reece. Biology. 6th Edition. USA. Pearson Education, Inc. 2002. 198 199 199 Freshney, R.I. Culture of Animal Cells: A Manual of basic techniques. 5th Edition. USA. Wiley-Liss Inc. 2005.
2. Gamborg, O. L. and G. C. Phillips. Plant cell, tissue, and organ culture: fundamental methods. Germany. Springer-Verlag. 1995.

Reference Books:

1. Masters J. R. W. (2000): Animal cell culture 3. iz. Oxford University Press, Oxford Butler M (2004): Animal cell culture & technology, 2. iz. Bios Scientific Publishers, London i New York
2. Freshney R. I. (2000): Culture of animal cells: A manual of basic technique. 4. iz. Willey-Lys, J.Willey & Sons. New York
3. Culture of Animal Cells: A Manual of Basic Technique (5th Edition) R. Ian Freshney. Wiley-Liss. It is in your best interest to bring this book to class.
4. www.zora.uzh.ch

COURSE OUTCOMES (COs)	
CO1	Understand the bulk development of serum free media.
CO2	Explain the method of Organ cultures and types of organ cultures
CO3	Strategies for gene transfer techniques in mammalian cells.
CO4	Understand the **c**ommercial production of monoclonal antibodies and their use for mankind
CO5	To know the viral vectors-general features, promoters used in expression vectors
CO6	To gain knowledge on Medical devices used for animal tissues cultures..

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE13	CLASSICAL AND MOLECULAR PLANT BREEDING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Molecular biology, plant biotechnology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To make understand of the plant breeding molecular biology engineering so as to help them to manipulate the cell to the basic requirements				

MODULE I: INTRODUCTION TO PLANT BREEDNG (9 Periods)

History and objectives of Plant Breeding, Characteristics improved by plant breeding; Patterns of Evolution in Crop Plants -biodiversity and its significance. Genetic basis of breeding, pollinated crops.

MODULE II: PEDIGREE ANALYSIS (9 Periods)

Crop plants Self-incompatibility and male sterility in and their commercial exploitation. Pure

line theory and mass selection methods; Line breeding, pedigree, bulk, backcross, single seed descent and multi-line method.

MODULE III: BREEDING METHODS (9 Periods)

Breeding methods in cross pollinated crops; Population breeding,S1 and S2 progeny testing, progeny selection schemes, Selection schemes for intra and inter-population improvement and development of synthetics and composites.

MODULE IV: CROP IMPROVEMENT (9 Periods)

Concept of plant ideotype and its role in crop improvement; Transgressive breeding. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses. Cultivar development- testing, release and notification.

MODULE V: ADVANCE BREEDING ANALYSIS (9 Periods)

Selection methods in segregating populations and evaluation of breeding material; Analysis of variance (ANOVA); Estimation of heritability and genetic advance; Maintenance of experimental records; Learning techniques in hybrid seed production using male-sterility in field crops.

Text Books:

1. Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
2. Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.
3. Chopra VL. 2004. Plant Breeding. Oxford & IBH.
4. Gupta SK. 2005. Practical Plant Breeding. Agribios.
5. Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH. • Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ House.

Reference Books:

1. Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
2. Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society
3. Singh BD. 2006. Plant Breeding. Kalyani. • Singh P. 2002. Objective Genetics and Plant Breeding. Kalyani.
4. Singh P. 2006. Essentials of Plant Breeding. Kalyani.
5. Singh S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding CBS.
6. http://sharebooks.com/system/files/Crop-Histories.pdf

COURSE OUTCOMES (COs)	
CO1	To understand the molecular biology
CO2	To know the methods of plant breeding.
CO3	To understand the Breeding methods in cross pollinated crops
CO4	To know Concept of plant ideo type and its role in crop improvement
CO5	To understand how to Maintain of experimental records
CO6	Learning techniques in hybrid seed production using male-sterility in field crops.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE21	CANCER BIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – System Biology, Genomics and proteomics				
	Course Designed by – Department of Genetic Engineering				
OBJECTIVES	1 To provide knowledge about biological aspects of cancer. 2. To impart basic concepts of cancer biology. 3. Various stages in carcinogenesis, molecular cell biology of cancer.				

MODULE I: FUNDAMENTALS OF CANCER BIOLOGY (9 Periods)

Regulation of cell cycle and mutations, effects on receptor, signal switches, tumor suppressor genes. Cancer screening and detection using biochemical assays, tumor markers, molecular tools for diagnosis of cancer. Cancer Epidemiology.

MODULE II: PRINCIPLES OF CARCINOGENESIS (9 Periods)

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

MODULE III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER (9 Periods)

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, Oncogenes/ proto oncogene activity, Growth factors related to transformation, Telomerases.

MODULE IV: PRINCIPLES OF CANCER METASTASIS (9 Periods)

Clinical significances of invasion, Heterogenicity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, Proteinases and tumor cell invasion.

MODULE V: NEW MOLECULES FOR CANCER THERAPY (9 Periods)

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer. Use of signal targets towards therapy of cancer; Gene therapy.

TEXT BOOKS

1. Maly B.W.J, "Virology. A Practical Approach", IRLl Press, Oxford, 1987.
2. Dunmock N. J and Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.

REFERENCE BOOKS

1. An Introduction Top Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.
2. Molecular Cell Biology, Sixth Edition by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew.
3. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology Michael Wink (Editor) 2006, John Wiley & Sons Publishers, Inc
4. **https://biology.mit.edu/research/cancer_biology**

COURSE OUTCOMES (COs)	
CO1	Fundamentals Of Cancer Biology
CO2	Principles Of Carcinogenesis
CO3	Principles Of Molecular Cell Biology Of Cancer
CO4	Principles Of Cancer Metastasis
CO5	New Molecules For Cancer Therapy
CO6	Cancer metastasis and cancer therapy.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE22	AGRI,VETERINARY AND MEDICAL INFORMATICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biopharmaceutical technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	1. To introduce the basic principles of computerized patent record 2. To understand the recent trends in medical informatics				

MODULE I: AGRICULTURAL INFORMATICS (9 Periods)

Introduction – plant genome, and Analysis of plant genome sequence, analysis of metabolites in plants, targeting study of compound against plant pathogens using bioinformatics tools.

MODULE II: VETERINARY INFORMATICS (9 Periods)

Introduction - history of pathogens, interaction between pathogens and host cell molecules using bioinformatics tools. Genome analysis for identification of diseases. Study of molecules and functional domain structure using bioinformatics tools

MODULE III: MEDICAL INFORMATICS (9 Periods)

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services.

MODULE IV: COMPUTERISED PATIENT RECORD (9 Periods)

Introduction, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

MODULE V: RECENT TRENDS IN MEDICAL INFORMATICS (9 Periods)

Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health.

TEXT BOOKS:

1.R.D. Lele Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd,2005, New Delhi

2.Mohan Bansal, Medical informatics Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi

REFERENCE BOOKS

1. Role of bioinformatics in agricultural - Santosh Kumar, 2014

2. Bioinformatics Sequence and Genome analysis - David W. Mount, 2003.

3. Bioinformatics Basics 'Applications in Biological science and Medicine" Hooman H. Rashidi & Lukas K. Buehie 2001.

http://www.omicsonline.org/

COURSE OUTCOMES (COs)	
CO1	To learn about HIS
CO2	It also gives knowledge on veterinary informatics
CO3	To understand the clinical information system
CO4	It deals with CPR in radiology
CO5	It imparts health care information
CO6	Ability to do docking methods

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE23	GENETIC ENGINEERING OF PLANTS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Genetics, plant biotechnology, Genomics.				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement				

MODULE I: PGR CONSERVATION METHODS (9 Periods)

Historical perspectives and need for PGR conservation; Importance of plant genetic resources; Taxonomical classification of cultivated plants; Centers of origin and global pattern of diversity; Basic genetic resources and transgenes.

MODULE II: GERM PLASM THEORY (9 Periods)

Principles, strategies and practices of exploration, collection, characterization, evaluation and cataloging of PGR; Plant quarantine and phytosanitary certification; Germplasm: Introduction and exchange; Principles of in vitro and cryopreservation.

MODULE III: GERMPLASM CONSERVATION (9 Periods)

Germplasm conservation- in situ, ex situ, and on-farm; short, medium and long term conservation strategies for conservation of orthodox seed and vegetatively propagated crops; Registration of plant genetic resources.

MODULE IV: DATABASE MANAGEMENT (9 Periods)

PGR data base management; Multivariate and clustering analysis, descriptors; National and international protocols for PGR management; PGR for food and agriculture (PGRFA); PGR access and benefit sharing; Role of CGIAR system in the germplasm exchange.

MODULE V : GENE ENHANCEMENT METHODS (9 Periods)

Genetic enhancement- need for genetic enhancement; Genetic enhancement and plant breeding; Reasons for failure in genetic enhancement; Sources of genes/ traits- novel genes for quality.

Text Books:

1. Frankel OH & Bennett E. 1970. Genetic Resources in Plants – their Exploration and Conservation. Blackwell. Gautam PL, Dass BS, Srivastava U & Duhoon SS. 1998. Plant Germplasm Collecting: Principles and Procedures. NBPGR, New Delhi.
2. Painting KA, Perry MC, Denning RA & Ayad WG. 1993. Guide Book for Genetic Resources Documentation. IPGRI, Rome, Italy.

Reference Books:

1. Paroda RS & Arora RK. 1991. Plant Genetic Resources, Conservation and Management. Concepts and Approaches. IPGRI Regional office for South and South Asia, New Delhi.
2. Rana RS, Sapra RL, Agrawal RC & Gambhir R. 1991. Plant Genetic Resources, Documentation and Information Management. NBPGR, New Delhi.
3.http://50.30.47.15/Ebook/Course_SUST_BMB/BMB_328/An_Introduction_to_Genetic_Engineering.pdf

COURSE OUTCOMES (COs)	
CO1	To understand the Importance of plant genetic resources;
CO2	To know the Basic genetic resources and transgenes
CO3	To understand the Germplasm conservation
CO4	To know the Role of CGIAR system in the germplasm exchange
CO5	To understand how to Maintain of experimental records
CO6	Learning techniques of Intellectual property, Patents, copyrights, trademarks and trade secrets.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE31	MOLECULAR MEDICINE AND HEREDITORY DISORDERS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Molecular modelling				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVE:	1. To gain knowledge of basic cytogenetic techniques. 2. To learn about biochemical method used to detect metabolic changes. 3. To learn about molecular methods to detect changes in the DNA. 4. To learn about molecular methods to detect changes in the RNA and protein				

MODULE I: INTRODUCTION TO MOLECULAR MEDICINE (9 Periods)

Introduction to Molecular Medicine: Overview of the subject -Molecular mechanisms in development and differentiation -Molecular and biomedical aspects of ageing

MODULE II: GENE EXPRESSION AND PROTEIN FUNCTIONAL DEFECTS IN DISEASE (9 Periods)

Vesicle trafficking in cells -Abnormal protein function and disease -Diseases of DNA repair and genomic instability -RNA processing and disease-Oncology-Chromosomal translocations and leukemia: identification of novel therapeutic targets-Molecular aspects of neurodegenerative disease.

MODULE III: MOLECULAR PHARMACOLOGY (9 Periods)

Pharmacogenetics -Drug discovery -Drug design and development -Molecular aspects of infectious diseases- Intracellular pathogens: Bacillary dysentery Extracellular pathogens: Botulism and tetanus -Viral pathogens: Dengue hemorrhagic fever.

MODULE IV: IMMUNOLOGICAL ASPECTS OF MOLECULAR MEDICINE

(9 Periods)

Autoimmunity and transplantation -Human genome and predisposition to autoimmunity - Transgenic models of autoimmunity-Lessons from animal models for manipulation of the immune system.

MODULE V: MOLECULAR BIOTECHNOLOGY (9 Periods)

9Recombinant proteins; state of the art, problems, new developments -Antibodies, design production, engineering -Peptides and derivatives as therapeutic agents- Nanotechnology and pharmaceuticals – Drug delivery systems-Commercialization -Clinical trials/ethics.

TEXT BOOKS

1. Medical Genetics 3rd Edition- Jorde, Carey, Bamshad & White.
2. Molecular pharmacology A short course by Jerry Kenatin: John Wiley and Sons publications.

REFERENCES:

1. Gary Walsh – "Proteins – Biochemistry and Biotechnology" Robert A. Meyers – Encyclopedia of Molecular Cell Biology and Molecular Medicine (Ed) – Vol I, II ed.
2. Barry Halliwell - Free Radicals in Health and Disease.
3. http://molmed.org/

COURSE OUTCOMES (COs)	
CO1	To learn about various diagnostic strategies to detect large deletions in chromosomes.
CO2	It also gives knowledge on efficient utilization of changes in gene expression at RNA and protein level.
CO3	It deals with protein truncation.
CO4	It imparts determination of splicing variants
CO5	Molecular pharmacology
CO6	Transgeneic animals study

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M

	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE32	**MICROBIAL GENETICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Cell biology, Genetics, and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various types of physical organization of bacterial genomes; genotype and phenotype.				

MODULE I: INTRODUCTION (9 Periods)

Eukaryotic and prokaryotic Genetics; physical organization of bacterial genomes; genotype and phenotype; dominance and recessive characters, molecular biology of bacterial cell division and plasmid replication.

MODULE II: GENE TRANSFER METHODS (9 Periods)

Molecular mechanism of transformation, conjugation and transduction; consequences of recombination; gene mapping; mosaic genes and chromosome plasticity.

MODULE III: MOVABLE GENETIC ELEMENTS (9 Periods)

Plasmids: structure, properties, functions and stability; transposons; mechanism of transposition; phase variation; CRISPR.

MODULE IV: REGULATION OF GENE EXPRESSION (9 Periods)

Induction and repression; operon model of gene expression; transcriptional control; promoter, terminator, attenuator and anti-terminator; two component regulatory pathway. Bacteriophage structure; ssDNA bacteriophage; RNA containing phages; dsDNA phages; genetics and molecular biology of λ (lambda) phage.

MODULE V: GENETICS OF YEAST (9 Periods)

Yeast as a model organism; advantages, life cycle, mating type switching in yeast; transformation and recombination; yeast artificial chromosome; yeast two-hybrid systems.

Text Book:

1.Briggs D. 1997. Plant Variation and Evolution. Science Publ.
2. Cronquist AJ. 1981. An Integrated System of Classification of Flowering Plants. Columbia Univ. Press.24
3.Dhillon BS, Varaprasad KS, Kalyani S, Singh M, Archak S, Srivastava U & Sharma GD. 2001. Germplasm Conservation A Compendium ofAchievements. NBPGR, New Delhi.
4.Castri F & Younes T. 1996. Biodiversity Science and Development: Towards New Partnership. CABI & International Union for Biol.Sci. France.
5.Gurcharan Singh. 2004. Plant Systematics: An Integrated Approach. Science Publ.

Reference Book:

1. Lawrence GMH. (Ed.). 1951. Taxonomy of Vascular Plants. London.
2. Paroda RS & Arora RK. 1991. Plant Genetic Resources Conservation and Management Concepts and Approaches. IPGRI Regional office for South and South Asia, New Delhi.
2. www.lamission.edu/lifesciences/steven/micro20%20chapter%208.**pdf**

COURSE OUTCOMES (COs)	
CO1	Understand the steps in dominance and recessive characters
CO2	Explain the features of various types of Gene transfer
CO3	mechanism of transposition
CO4	gene expression; transcriptional control;
CO5	Plasmid expression vectors- restriction and modification
CO6	To gain knowledge on various Genetics of yeast and their applications.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE33	**HERBAL DRUGS AND GENOMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Herbal studies, Principles of genomics, Plant biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various types of physical organization of Medicinally important Plants				

MODULE I: INTRODUCTION TO HERBAL DRUGS (9 Periods)

Introduction to Medicinally important Plants. Plant parts: Fruits, Leaves, Stem and its modifications. Plant identification – Herbarium techniques. Medicinal plants – role in human health care.

MODULE II: SCOPE OF ETHNOMEDICINE (9 Periods)

Ethnomedicine – definition, history and its scope – Traditional knowledge and utility of some medicinal plants in Tamilnadu – Solanum trilobatum, Cardiospermum halicacabum, Adathoda vasica, Azadirachta indica, Phyllanthus fraternus and Boerhaavia diffusa.

MODULE III: PHARMOCOGNOSY (9 Periods)

History, Definition and scope of pharmacognosy; Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies. Ayurveda, Traditional Chinese medicine and Korean medicines. Chemistry of drugs and its evaluation.

MODULE IV: HERBAL MEDICINE GENOMICS (9 Periods)

Introduction to Herbal medicine genomics, Pharmacogenomics of Herbal drugs, application of Bioinformatics tools in Herb- drug interactions and their influence in gene expression, Herbal drugs used for Asthma, cancer , genetic disorders,antimicrobials, acute and chronic diseases.

MODULE V: GENE EXPRESSION METHODS (9 Periods)

Ayugenomics, Plant medicine genomics, case studies on herbal medicines and their effects in gene expression. Psychoactive drugs –Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.

Text Books:

1. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi. 2. Rao, A.P. Practicals:
2. Gokhale, S.S., C.K.Kokate and A.P. Purohit (1994) Pharmacognosy. Nirali Prakashan. Pune.
3. Tyagi, Dinesh Kumar (2005) Pharma Forestry. Field Guide to Medicinal Plants. Atlantic Publishers and Distributors, New Delhi.
3. Faroogi, A.A., and B.S. Sreeramu (2004). Cultivation of Medicinal and Aromatic Crops. University Press (India) Pvt. Ltd., Hyderabad.

Reference:

1. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
2. Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta –700 006.
3. Contribution to Indian ethnobotany – S.K. Jain 1995, 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
4. A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.
5. https://www.sciencemag.org/.../art-and-science-traditional-medicine-part

COURSE OUTCOMES (COs)	
CO1	Understand the steps in Herbarium techniques

CO2	Explain the Current approaches for drug discovery from herbal medicines.
CO3	Definition and scope of pharmacognosy
CO4	Chemistry of drugs and its evaluation
CO5	drug interactions and their influence in gene expression
CO6	To gain knowledge on various Psychoactive drugs

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE41	**PHARMACOGENOMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Pharmacology, Principles of genomics,				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various Pharmaceutical industry & development of drugs.				

MODULE I: INTRODUCTION (9 Periods)

Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses; economics and regulatory aspects. Various steps in new drug developments andpreparation.

MODULE II: DRUG ACTION, METABOLISM AND PHARMACOKINETICS (9 Periods)

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; Pharmacology, Pharmacogenomics and pharmaco kinetics.

MODULE III: MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS (9 Periods)

Types of reaction process and special requirements for bulk drug manufacture. Toxicology. Fermentation technology. Bioprocess technologies.

MODULE IV: PRINCIPLES OF DRUG MANUFACTURE (9 Periods)

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

MODULE V: BIOPHARMACEUTICALS (9 Periods)

Various categories of therapeutics like Vaccines, life saving drugs, antibodies, vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

TEXT BOOKS

1. Gareth Thomas, Medicinal Chemistry. An introduction by .John Wiley. 2000.
2. Katzung B.G., Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3.Brahmankar, D.M., "Biopharmaceutical and Pharmacokinetics: A Treatise", Vallabh Prakashan, 1995.

REFERENCE BOOKS

1. Niazi, Sarfaraz K. "Handbook of Bio-generic Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues". CRC Press, 2006.
2. Ho, Reedney J. Y., MiloGibaldi. "Biotechnology & Biopharmaceuticals Transforming Proteins and Genes into Drugs". Wiley Liss, 2003.
3. http://www.btci.org/aket.bt

COURSE OUTCOMES (COs)	
CO1	Understand the steps in Various steps in new drug developments
CO2	Explain the Current approaches for Mechanism of drug action.
CO3	special requirements for bulk drug manufacture
CO4	Chemistry of drugs and its evaluation
CO5	Tests used in drug manufacture; packing techniques
CO6	Various categories of therapeutics like Vaccines

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCGE42	PROTEIN ENGINEERING	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Genomics and Proteomics, System Biology				
	Course Designed by – Department of Genetic Engineering				
OBJECTIVES	1. To understand the principle of nucleic acid isolation. 2. To understand the principles of PCR and their uses in genetic engineering.				

MODULE I: INTRODUCTION TO PROTEIN ENGINEERING (12 Periods)

Introduction to proteins. Genes and proteins. Proteomics. Basics of protein synthesis. Types and classification of proteins. Primary structure, secondary structure, tertiary structure, quaternary structure, Ramachandran plot.

MODULE II: PROTEIN STRUCTURE PREDICTION (12 Periods)

Strategies for design of novel proteins-strategies for the design of structure and function, computer methods in protein modelling. Bioinformatics tools in protein studies.

MODULE III: PRODUCTION OF NOVEL PROTEINS (12 Periods)

Site and strategies for heterologous expressions, methods for expressing recombinant proteins in yeast, in vitro mutagenesis. Yeast two Hybrid system.

MODULE IV: CHARACTERIZATION OF PROTEINS (12 Periods)

Traditional and advanced methods in protein characterizations. NMR spectroscopy, crystallography, spectroscopic and calorimetric methods.

MODULE V: APPLICATIONS OF PROTEIN ENGINEERING (12 Periods)

Application of protein engineering in industries. Design of polymeric biomaterials, nicotinic acetylcholine receptors as a model for a super family of ligand - gated ion channel proteins

TEXT BOOK:

1. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages
2. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
3. Models of Proteins and Nucleic Acids. Cambridge University Press, 1998

REFERENCE BOOKS

1. Proteomics from protein sequence to function: Edited by S.R.Pennington and M.J.Dunn,Taylor and Francis Group, 2001.
2. Biophysical Chemistry, Cantor and Schimmel, part I and II, W.H. Freeman and co 1997.
3. http://nptel.ac.in/courses/102103017/pdf/lecture%2022.pdf

COURSE OUTCOMES (COs)	
CO1	This course imparts the knowledge on the principles on nucleic acid isolation and purification.
CO2	It also gives knowledge on history and latest methods of DNA sequencing..
CO3	It deals with the protein – protein interaction.
CO4	It imparts protein sequencing methods.
CO5	To gain a thorough knowledge about nucleic acid hybridization.
CO6	To learn history of DNA sequencing and current methods and gene synthesis.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE43	BIOCONFINEMENT OF GENETICALLY MODIFIED ORGANISMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biology, Plant and animal biotechnology and rDNA Technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	Gain knowledge on basic developmental aspects of plant that can be transformed into research application.				

MODULE I: INTRODUCTION TO BIOCONFINEMENT (9 Periods)

History of Confinement – Applications of Genetically modified organisms in medicine and Agriculture. Methods of Bio confinement, International Aspects -Social Acceptability of Bio confinement Methods.

MODULE II: NEED FOR BIOCONFINEMENT (9 Periods)

Risk factors - Effects on Non-target Species - Delaying the Evolution of Resistance - Food Safety and Other Issues - Need for Bio confinement.

MODULE III: BIOCONFINEMENT OF PLANTS AND ANIMALS (9 Periods)

Genetically Engineered Trees - Transgenic Grasses - Transgenic Algae-Effectiveness at Different Spatial and Temporal Scales - Monitoring and Managing Confinement Failure -bio confinement of fish, and insects.

MODULE IV: BIOCONFINEMENT OF VIRUSES (9 Periods)

Introduction - Potential Effects or Concerns, and Need for Bio confinement in Viruses, Fungi, and Bacteria.

MODULE V: BIOLOGICAL AND OPERATIONAL CONSIDERATIONS FOR BIOCONFINEMENT (9 Periods)

Execution of Confinement - International Aspects - Bio confinement - Bio confinement Research

TEXT BOOK

1. Biological confinement of genetically engineered organisms by national research council: National Academic press.
2. Piefzer F.M. Food Microbiology, Academic Press, 1989.

REFERENCE BOOKS

1. Sasson A, Biotechnologies and Development, UNESCO Publications

COURSE OUTCOMES (COs)	
CO1	The course imparts advanced knowledge on genetically modified organisms.
CO2	It also gives knowledge on efficient utilization of the principles of bioconfinement.
CO3	It deals with transgenic algae.
CO4	It imparts determination of bioconfinement research.

CO5	To apply the modular approach and regulatory networks present in a cell.
CO6	To Possess requisites for plant signal transduction research.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE51	**STEM CELL BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basics of Genetic Engineering, rDNA Technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To enable understanding chemical principles governing biochemical reactions				

MODULE I: STEM CELL BASICS (9 Periods)

Unique properties of stem cells – embryonic stem cells - adult stem cells – umbilical cord stem cells – similarities and differences between embryonic and adult stem cells. Properties of stem cells.

MODULE II: EMBRYONIC STEMCELLS (9 Periods)

Invitro fertilization – human embryonic stem cells – blastocyst – innercell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells – human ES cells – Monkey and Mouse ES cells.

MODULE III: ADULT STEM CELLS (9 Periods)

Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.

MODULE IV: STEM CELL IN DRUG DISCOVERY AND TISSUE ENGIEERING **(9 Periods)**

Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – stem cell based drug discovery platforms, drug screening and toxicology.

MODULE V: **GENETIC ENGINEERING AND THERAPEUTIC APPLICATION OF STEM CELLS** **(9 Periods)**

Stem cells and transgenic animals – Biomarkers in Cancer – Therapeutic applications – Neurological disorder – limb amputation – heart disease - spinal cord injuries – diabetes – burns.

TEXT BOOKS

1. Stem cells Hand Book by Stewart Sell
2. Stem cell Research by Nancy E. Snow

REFERENCE BOOKS

1. Human Embryonic Stem cells by Ann.A. Kiessling
2. Stem cell and future of regenerative medicine. National Academic press
3. Stem cell and Cloning by David A. Prentice and Michael A. Palladin.
4. www.nature.com/**stemcells/links**.html
5. www.ukaachen.de/.../division-of-**stem-cell-biology**-and-**cellular**-engineer

COURSE OUTCOMES (COs)	
CO1	Understand Unique properties of stem cells.
CO2	Invitrofertilization
CO3	Understand the Somatic stem cells
CO4	Understand the Target identification differentiation pathways.
CO5	understand the production of complete organ
CO6	Characteristics of application in stem cell theraphy

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M

	CO5		H	M		M		H	M		M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE52	STRESS TOLERANCE IN PLANTS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biology, Enzyme Technology and Bioreactors design				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To understand the basic concepts of filtration and agitation and mixing. To study the nature of fluids and flow characteristics.				

.**MODULE I: ABIOTIC AND BIOTIC STRESSES AND THEIR EFFECTS ON PLANTS (9 Periods)**

Salinity, drought, high temperature, cold stress, UV radiation, heavy metals, pathogens, pest infestation.

MODULE II: REACTIVE OXYGEN SPECIES AND ANTIOXIDANTS IN PLANTS (9 Periods)

ROS – generation and effects; Functions and metabolisms of antioxidants – glutathione, thiols, ascorbate, tocopherol, carotenoids, phenolics.

MODULE III: ENZYMES INVOLVED IN STRESS DEFENCE (9 Periods)

Catalase, ascorbate peroxidase, superoxide dismutase. Genetic engineering OF Stress tolerance: Case studies involving development of stress tolerant plants.

MODULE IV: STRESS SIGNALLING PATHWAYS (9 Periods)

Abiotic stress signalling and transduction pathways; Ethylene pathway; Ubiquitin and biotic stress tolerance; Ca2+ and calmodulin signal transduction; The ascorbate (AsA)-glutathione (GSH) pathway; Mitogen-activated protein kinase pathway.

MODULE V: STRESS TOLERANCE MECHANSIMS (9 Periods)

Heat shock proteins; Amino acids in plant responses and adaptation to heavy metal stress; Transcription factors in stress tolerance; Role of membrane transporters; Mechanisms of heavy metal detoxification and tolerance.

TEXTBOOKS:

1. Pareek A, Sopory S K and Bohnert H J (Eds), "Abiotic Stress Adaptation in Plants: Physiological, Molecular and Genomic Foundation", Springer, 2010.
2. Smirnoff N (Ed), "Antioxidants and Reactive Oxygen Species in Plants", Wiley-Blackwell, 2005.
3. Slater A, Scott N and Fowler M, "Plant Biotechnology- The genetic manipulation of plants", Oxford press, Oxford, 2003.

REFERENCE BOOKS:

1. Dreher K and Callis J, "Ubiquitin, Hormones and Biotic Stress in Plants", Annals of Botany 99: 787–822, 2007.
2. Fedoroff N, "Redox Regulatory Mechanisms in Cellular Stress Responses", Annals of Botany 98: 289–300, 2006.
3. Hall J L, "Cellular Mechanisms for Heavy Metal Detoxification and Tolerance", J. Exp. Bot. 53: 1 – 11, 2002.
4. Jonak C, Nakagami H and Hirt H, "Heavy Metal Stress. Activation of Distinct Mitogen-Activated Protein Kinase Pathways by Copper and Cadmium", Plant Physiol 136:3276-3283, 2004.

COURSE OUTCOMES (COs)	
CO1	To learn about biotic and abiotic stress in plants.
CO2	It also gives knowledge on ubiquitin hormones
CO3	It deals with modern regulatory mechaniss in plants
CO4	It imparts modeling of cellular mechanism in plants
CO5	To familiarize the mass transfer operations in production of plants
CO6	4. To understand the principles of heavy metal stress in plants

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional core (PC)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE53	FOOD PROCESS TECHNOLOGY AND QUALITY CONTROL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biotechnology, Food Toxicology, microbiology, Food Engineering				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	Impart education in the field of Food processing Technologies in order to generate competent resources to meet the demands of the fast-growing Dairy and Food Industry.				

MODULE I : QUALITY CONTROL ANALYSIS (9 Periods)

Storage of cereals, Processing of rice and rice products. Milling of wheat and production of wheat products, Processing of tea, coffee and cocoa, Storage and handling of fresh fruits and vegetables.

MODULE II: PRESERVATION METHODS (9 Periods)

Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of Fish; Methods of Preservation of fish.

MODULE III: FERMENTATION TECHNOLOGY (9 Periods)

Meat cuts and portions of meat, muscle; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products; Frozen meat & meat storage; By-products from meat industries and their utilization; Meat industries in India.

MODULE IV: FERMENTATION TECHNOLOGY (9 Periods)

Pasteurization of milk; HTST and UHT techniques; Packaging of milk; Fermentation of milk and fermented milk products. Manufacture of milk products like evaporated milk, powder milk, condensed milk.

MODULE V: EXTRACTION METHODS (9 Periods)

Importance of fats and oils in foods; Sources of fats and oils; Extraction of fats and oils – rendering, pressing, solvent extraction; Processing of oils – degumming, refining, bleaching, deodorization, fractionation.

TEXT BOOKS:

1. Food Science by Potter
2. Technology of Food Preservation by Desrosier
3. Principles of Food Science, Vol-I by Fennma Karrel
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon
5. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC 6. Food science by Mudambi.

REFERENCE BOOKS

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
4. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.

5. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub
6. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.
7. https://www.uoguelph.ca/foodscience/book-page/dairy-science-and-technology-ebook

COURSE OUTCOMES (COs)	
CO1	To gain knowledge on storage, preparation, preservation and packaging of food products and beverages
CO2	Understand the Food Laws, food rules and standards, Statistical Quality Control
CO3	To learn about commercial handling of fish
CO4	To gain knowledge on slaughtering techniques and meat products
CO5	Impart knowledge on dairy and food industry
CO6	Know about the importance and processing of oil

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE61	**Metabolism and Metabolomics**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biopharmaceutical technology				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES	1. This course provides the fundamental knowledge on upcoming field of metabolomics 2. The metabolic engineering in post genomic era.				

	3. Understand Regulation of metabolic pathways and examples of pathway manipulations **4.** Provides knowledge about the metabolic engineering in database.

MODULE I: INTRODUCTION (9 Periods)

Introduction to metabolic engineering-Metabolism- Stoichiometry, reaction rates and dynamic mass balances-Growth Energetic-Yield coefficients and linear rate equations.

MODULE II: METABOLIC PATHWAY REGULATION (9 Periods)

Regulation of metabolic pathways-Examples of pathway manipulations. Alteration of feedback regulation, limiting accumulation of end products. Induction-jacob & monod model, catabolic regulation.

MODULE III: METABOLIC FLUX ANALYSIS (9 Periods)

Metabolic flux analysis-Methods for the experimental determination of metabolic flux using isotope labelling-Applications of Metabolic flux labelling. Metabolic control analysis.

MODULE IV: BIOCONVERSIONS (9 Periods)

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions.

MODULE V: PLANT METABOLIC ENGINEERING (9 Periods)

Metabolic Engineering in plants- Metabolomics and Metabolic engineering-Introduction to Databases on the web.

TEXT BOOKS

1.Fermentation and Enzyme Technology, John Wiley and Sons, 1980.
2.Stanbury P.F., and Whitaker A., "Principles of Fermention Technology", Pergamon Press, 1984.

REFERENCE BOOKS

1. Zubay G., "Biochemistry ", Macmillan Publishers, 1989.
2. Harper's review of biochemistry By David, W. Martin, Peter.A.Mayes, Victor.W. Rodwell, LANGE medical publications.
3. Practical Biochemistry – Principles & Techniques by Keith Wilson & John Walker. Oxford University press.
4. Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Neilsen, Metabolic engineering: Principles and Methodologies San Diege: Academic Press, 1998.

COURSE OUTCOMES (COs)	
CO1	Metabolic engineering
CO2	Comprehensive models cellular reactions
CO3	Metabolic flux analysis and its applications
CO4	Metabolomics and its study

CO5	Applications of metabolomics
CO6	Metabolism of Plants and animals

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE62	**INDUSTRIAL MICROBIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology, Industrial Biotechnology				
	Course Designed by – Department of Genetic Engineering				
OBJECTIVES	1. To develop their practical skills in microbial fermentation techniques. 2. To evaluate enzyme kinetics.				

MODULE I: INTRODUCTION AND HISTORY (9 Periods)

Scope and Roles. Fundamentals and characteristics of microbes in bioprocess technology; nomenclature and classification of microbes; review of microbes commonly used in bioprocess industries.

MODULE II: MICROORGANISMS OF INDUSTRIAL IMPORTANCE (9 Periods)

Selection of Microorganisms; Screening, Selection and identification of strains; Types of stock culture, Strain Preservation of Industrial Microorganisms Medium requirements for fermentation process.

MODULE III: PRODUCTION OF PRIMARY AND SECONDARY METABOLITES (9 Periods)

Production of primary and secondary metabolites Processes for the production of commercially important Organic acids, Amino acids and Alcohols. Production process for various antibiotics.

MODULE IV: PRODUCTION OF COMMERCIALLY IMPORTANT ENZYMES AND PROTEINS (9 Periods)

Commercially important enzymes for food and pharmaceutical industries; Production of recombinant proteins in therapeutic and diagnostic applications; production of vaccines.

MODULE V: FERMENTATION (9 Periods)

Design of fermentor, fermentation media and substrates. Types of Fermentation Processes- Surface, Submerged and Solid state fermentation, Batch and Continuous fermentation.

TEXT BOOKS

1. L. E. Casida, Industrial Microbiology. Wiley Eastern Ltd., 1989
2. Text book of microbiology by Tortara, 2005

REFERENCE BOOK

1. G. Reed, Prescott and Dunn's Industrial Microbiology (4th Ed.).CBS Publishers, 1987.
2. H. J. Rehm, G. Reed and H. Pape (Eds.) Biotechnology (A Comprehensive Treatise vols. 1-8). VCH, 1986
3. Crueger and A. Crueger; Biotechnology: A Textbook of Industrial Microbiology (Eng. Ed. T. D. Brook). Sinaeur Associates, 1990.
4. http://www.sysmex-partec.com/applications/microbiology-industrial-applications.html

COURSE OUTCOMES (COs)	
CO1	Enables the student to develop their skills in the field of microbial fermentation technology.
CO2	It also gives knowledge on history and latest methods of enzyme kinetics.
CO3	It deals with the antibiotic production.
CO4	It imparts anaerobic fermentation methods.
CO5	To carry out enzyme immobilized reaction.
CO6	To develop the practical skills in solid substrate fermentation in wine production.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M

	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEGE63	**PLANT PHYSIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Cell biology, Genetics, Phytochemistry and Botany				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various aspects of plant physiology, such as respiration, enzyme action, and water relations				

MODULE I: INTRODUCTION TO PLANT PHYSIOLOGY (9 Periods)

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. Generation of EDVs.

MODULE II: TISSUE CULTURE TECHNOLOGY (9 Periods)

Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

MODULE III: RFLP ANALYSIS (9 Periods)

Techniques of DNA isolation, quantification and analysis; Sequencing techniques; Vectors, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers mapping populations.

MODULE IV: MOLECULAR MAPPING METHODS (9 Periods)

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; Gene pyramiding.

MODULE V: CROP IMPROVEMENT METHODS (9 Periods)

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding,

TEXT BOOKS:

1. Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology:Concepts, Methods and Applications. Oxford & IBH.
2. Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
3. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.

REFERENCE BOOKS

1. Sambrook J & Russel D. 2001. *Molecular Cloning* - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
2. Singh BD. 2005. *Biotechnology, Expanding Horizons*. Kalyani.
3. https://archive.org/details/PlantPhysiology_201408

COURSE OUTCOMES (COs)	
CO1	To learn about plant breeding
CO2	To gain knowledge on tissue culture and hybridization techniques
CO3	Understand Genotyping and Sequencing techniques
CO4	To know about Molecular mapping and tagging of agronomical traits
CO5	To learn about Gene pyramiding
CO6	To gain knowledge on Genomics and genoinformatics for crop improvement.

Mapping of Course Outcomes with PROGRAMME OUTCOMES (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H			M		H		M		H	H
	CO2	H	M		H		M		M		H		
	CO3			M		M		H		H		M	H
	CO4	H	M		H		M				L	M	M
	CO5		H	M		M		H	M		M	H	M
3	Category	Professional Elective (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

OPEN ELECTIVES FROM GENETIC ENGINEERING

U18OEGE001	METAGENOMICS AND EPIGENOMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various aspects of epigenetic characters of chromosomes				

MODULE I: TECHNIQUES AND STRATEGIES FOR METAGENOMIC ANALYSIS (9 Periods)

Tools used for identifying diversity, searching for novel genes and gene products, and investigating relationships among genes, mRNAs, and proteins in microbial communities. NGS for metagenome analysis.

MODULE II: APPLICATIONS OF METAGENOMICS (9 Periods)

Metagenomic applications in agriculture, environment and health. Applications of metagenomics in plant-microbe interactions, bioremediation, for industrial bioproducts.

MODULE III: EPIGENETIC AND EPIGENOME REGULATION (9 Periods)

Histone modifications and epigenetic information, transcription in chromatin environment, Techniques used in the study of transcription factor binding and DNA methylation.

MODULE IV: TECHNIQUES USED IN EPIGENOME ANALYSIS (9 Periods)

ChIP sequence, ChIP- PCR, bisulfate sequencing, enzyme based methods, Epigenome systems - Human epigenome, epigenomics in plants, fungi.

MODULE V: APPLICATIONS OF EPIGENOMICS (9 Periods)

Epigenetic regulation in stem cells, epigenetic of the immune system, epigenetics in neuronal diseases, Cancer epigenomics.

TEXT BOOKS:

1. Diana Marco, editor. Metagenomics: Theory, methods, and applications. Caister Academic Press, Norfolk, UK; 2010.
2. Nessa Carey, “The epigenetic regulation”, Columbia University Press, 2011.

REFERENCE BOOKS:

1. Robert A Myers, “Epigenetic regulation and Epigenomics”, Wiley- Blackwell, 2012.

COURSE OUTCOMES (COs)	
CO1	To learn about metagenomes
CO2	To gain knowledge on epigenetic regulation
CO3	Understand metagenomics theory and applications
CO4	To know about non coding RNA function
CO5	To learn about epigenomics in plants and fungi

CO6	To gain knowledge on cancer epigenomics

U18OEGE002	MOLECULAR GENETICS AND GENOMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To learn various aspects of molecular genetics				

MODULE I - INTRODUCTION TO MOLECULAR GENETICS & GENOMICS

(9 Periods)

History of DNA molecule & discovery -Physical nature of DNA –Genes function at Molecular level – Replication, Transcription & Translation, post-transcriptional modification in Eukaryotes, The Genetic Code.

MODULE II - MOLECULAR BIOLOGY OF DNA REPLICATION

(9 Periods)

Multiple Origins & bi-directional DNA replication in Eukaryotes, Replication of Virus & Theta replication of Circular DNA molecules, Rolling Circle replication, Plasmid DNA using a Rolling Circle, initiation by a Primosome complex.

MODULE III - MOLECULAR BIOLOGY OF RECOMBINATION (9 Periods)

Molecular mechanisms of Recombination, Gene conversion, Mismatch repair, Single strand break & repair model. Regulation of Gene Expression – Regulation of gene expression at many levels.

MODULE IV - GENOMIC POSITION EFFECTS ON GENE EXPRESSION

(9 Periods)

Molecular mechanisms of Gene Regulation – Transcriptional regulation in Prokaryotes, Lactose metabolism & the Operon system of Gene regulation, regulation of Tryptophan operon, regulation in Bacteriophage Lambda.

MODULE V - RNA MOLECULES & RNA PROCESSING (9 Periods)

Gene structure, Structure & Processing of messenger RNA, transfer RNA, ribosomal RNA, small interfering RNAs & micro RNAs, regulation through RNA processing and mRNA stability.

TEXT BOOK

1. Joseph Sambrook, David William Russell "Molecular cloning". 3rd Edition, CSHL Press, 2001.

REFERENCES

1) Daniel L. Hartl & Elizabeth W. Jones : Genetics – analysis of Genes & Genomes
2) Alan G. Atherly, Jack R. Girton & John F. McDonald: The Science of Genetics
3) Benjamin A. Pierce : genetics – a conceptual approach

COURSE OUTCOMES (COs)	
CO1	To learn about molecular genetics and genomics
CO2	To gain knowledge on DNA replication
CO3	Understand gene recombination
CO4	To know about transcriptional control unit
CO5	To learn about tryptophan operon
CO6	To gain knowledge on mRNA stability

U18OEGE003	PRINCIPLES OF MOLECULAR CELL BIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES	To understand the significance of Molecular cloning mechanism				

MODULE I: RECOMBINANT DNA TECHNOLOGY AND MOLECULAR CLONING (9 Periods)

Cloning overview, Gene library, Hybridization, molecular cloning, construction of DNA library, Library screening, Expression libraries, Restriction mapping, RFLP, DNA sequencing.

MODULE II: PURIFICATION AND SEPARATION OF NUCLEIC ACIDS (9 Periods)

Extraction and Purification of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis - Cutting and Joining DNA – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends.

MODULE III: VECTORS (9 Periods)

Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors: YACs and BACs.

MODULE IV : GENE RECOMBINATION AND GENE TRANSFER (9 Periods)

Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion,

MODULE V: TOOLS FOR ANALYZING GENE EXPRESSION (9 Periods)

Reporter Genes – Commonly used reporter genes, Analysis of gene regulation Purification and detection tags. Analysis at the level of gene transcription – Northern blot, in situ hybridization, Rnase protection assay.

TEXT BOOKS:

1.Glick B R, Pasternak J J and Patten C L, “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, ASM Press, Washinton D.C, 2010.
2. Primrose S B and Twyman R, “Principles of Gene Manipulation and Genomics”, John Wiley & Sons, USA, 2013.
3. Alexander N Glazer and Hiroshi Nikaido, “Microbial Biotechnology: Fundamentals of Applied Microbiology”, Cambridge, University Press, 2007.
4. Brown T A, “Gene Cloning and DNA Analysis: An Introduction”, John Wiley & Sons, New York, 2013.
5. Shuler M L and Kargi F, “Bioprocess Engineering – Basic Concepts”, Prentice Hall, New Delhi, 2002.

REFERENCE BOOKS:

1. Walsh and Gary, "Therapeutic Insulins and Their Large-Scale Manufacture", Applied Microbiology and Biotechnology. 67 (2): 151–159, 2005
2. Fang W, Vega-Rodríguez J, Ghosh A, Jacobs-Lorena M, Kang A, and St. Leger R, “Development of Transgenic Fungi That Kill Human Malaria Parasites in Mosquitoes”, Science. 25; 331, 2011.

COURSE OUTCOMES (COs)	
CO1	To explain various types of molecular cloning method
CO2	Demonstrate about purification of nucleic acids
CO3	Apply, solve and interpret the super vectors
CO4	To interpret bacterial conjugation
CO5	Predict and understand reporter genes
CO6	To understand the fundamentals of gene expression tools

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the students admitted from July 2018)
B.TECH – INDUSTRIAL BIO TECHNOLOGY
I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	U18ESCS1L1	ES	Problem Solving and Python ProgrammingLab	3	0	0	3	1.5
8	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
9	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
PHYSICAL ACTIVITY BASED COURSES								
10	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
Total				35	15	1	19	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
S. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	3	1	0	4
3	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3

4.	U18ESGE201	ES	Cytology and Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
PHYSICAL ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	14	2	20	25.5

SEMESTER III								
S.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT301	PC	Introduction to Molecular biology	2	2	0	0	2
2	U18PCBT302	PC	Principles of Chemical Engineering	3	2	1	0	3
3	U18PCBT303	PC	Biochemistry	3	3	0	0	3
4	U18PCBT304	PC	Microbiology	3	3	0	0	3
5.	U18PCBT305	PC	Instrumentation for Biotechnology	2	2	0	0	2
6	U18BSMA305	BS	Transforms and Numerical Methods	4	3	1	0	4
PRACTICAL								
7	U18PCBT3L1	PC	Biochemistry Lab I	2	0	0	2	1
8	U18PCBT3L2	PC	Cell Biology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	25	15	2	8	19

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**

THEORY								
1	U18PCBT401	PC	Plant Biotechnology	3	3	0	0	3
2	U18PCBT402	PC	Principles of Chemical Thermodynamics	3	2	1	0	3
3	U18PCBT403	PC	Unit Operations	3	2	1	0	3
4	U18PCBT404	PC	Introduction to Industrial Biotechnology	2	2	0	0	2
5.	U18PCBT405	PC	Bioorganic chemistry	2	2	0	0	2
6	U18PCBT406	PC	Immunology	3	3	0	0	3
7	U18PCBT407	PC	Recombinant DNA Technology	3	3	0	0	3
8	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
9	U18PCBT4L1	PC	Microbiology Lab	2	0	0	2	1
10	U18PCBT4L2	PC	Biochemistry Lab - II	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	29	19	2	8	21

SEMESTER V								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA501	BS	Statistics for Bio Science	4	3	0	0	3
2	U18HSBA502	HS	Organizational behaviour	3	3	0	0	3
3	U18PCBT501	PC	Principles of Bioprocess Technology	3	2	1	0	3
4	U18PCBT502	PC	Chemical Reaction Engineering	3	2	1	0	3
5.		PE	Professional Elective -I	3	3	0	0	3
6		PE	Professional Elective -II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
8	U18PCBT5L1	PC	Molecular biology & Genetic Engineering Lab	2	0	0	2	1
9	U18PCBT5L2	PC	Chemical Engineering lab	2	0	0	2	1
10	U18EEBT5C1	EE	Comprehension - I	0	0	0	0	1
ACTIVITY BASED COURSES								
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	29	18	3	8	21

SEMESTER VI								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT601	PC	Animal Biotechnology	2	2	0	0	2
2	U18PCBT602	PC	Enzyme Engineering and Technology	3	2	1	0	3
3	U18HSBT601	HS	Bio entrepreneurship Development	3	3	0	0	3
4	U18PCBT603	PC	Bioprocess Engineering	3	2	1	0	3
5.		PE	Professional Elective -III	3	3	0	0	3
6		OE	Open elective I	3	3	0	0	3
7	U18MCTH603	MC	Essence of Indian knowledge Tradition	2	2	0	0	0
PRACTICAL								
8	U18PCBT6L1	PC	Bioprocess Engineering Lab I	2	0	0	2	1
9	U18PCBT6L2	PC	Plant and Animal Biotechnology Lab	2	0	0	2	1
10	U18PCBT6L3	PC	Immunology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
12	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	29	17	2	10	20

SEMESTER VII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT701	PC	Down Stream processing	3	3	0	0	3
2	UI8PCBT702	PC	Research methodology and Instrumentation	2	2	0	0	2
3	UI8PCBT703	PC	Nanobiotechnology	3	3	0	0	3
4		PE	Professional elective IV	3	3	0	0	3
5		PE	Professional elective V	3	3	0	0	3
		OE	Open elective II	3	3	0	0	3
PRACTICAL								
6	U18PCBT7L1	PC	Bioprocess Engineering Lab II	2	0	0	2	1
7	U18PCBT7L2	PC	Downstream processing Lab	2	0	0	2	1
8	U18EEBT7P1	EE	Project I	6	0	0	6	3
9	U18EEBT7I1	EE	Internship (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	31	17	0	14	23

SEMESTER VIII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional elective VI	3	3	0	0	3
2		OE	Open elective III	3	3	0	0	3
3		OE	Open elective IV (MOOC)	2	2	0	0	2
PRACTICAL								
4	U18EEBT8C2	EE	Comprehension – II	0	0	0	0	1
5	U18EEBT8P2	EE	Project II	18	0	0	18	9
ACTIVITY BASED COURSES								
6	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	28	8	0	20	18

TOTAL CREDITS: 168

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE I						
COURSE CODE	**SPECIALISATION**	**COURSE NAME**	**L**	**T**	**P**	**C**
U18PEBT011	Food Processing Technology	Basic Human Nutrition	3	0	0	3
U18PEBT012	Medical Biotechnology	Medical biotechnology	3	0	0	3
U18PEBT013	Environmental biotechnology	Environmental Biotechnology	3	0	0	3
PROFESSIONAL ELECTIVE II						
U18PEBT021	Food Processing Technology	Dairy Technology	3	0	0	3
U18PEBT022	Medical Biotechnology	Cancer biology	3	0	0	3
U18PEBT023	Environmental biotechnology	Fertilizer Technology	3	0	0	3
PROFESSIONAL ELECTIVE III						
U18PEBT031	Food Processing Technology	Food Process Technology	3	0	0	3
U18PEBT032	Medical Biotechnology	Proteogenomics and Bioinformatics	3	0	0	3
U18PEBT033	Environmental biotechnology	Waste Management Technology	3	0	0	3
PROFESSIONAL ELECTIVE IV						
U18PEBT041	Food Processing Technology	Food safety and Quality control	3	0	0	3
U18PEBT042	Medical Biotechnology	Stem cell and Tissue Engineering	3	0	0	3
U18PEBT043	Environmental biotechnology	Biofuel Technology	3	0	0	3
PROFESSIONAL ELECTIVE V						
U18PEBT051	Food Processing Technology	Bioreactor design	3	0	0	3
U18PEBT052	Medical Biotechnology	Developmental Biology	3	0	0	3
U18PEBT053	Environmental biotechnology	Industrial waste treatment and disposal	3	0	0	3
PROFESSIONAL ELECTIVE VI						
U18PEBT061	Food Processing Technology	Fermentation technology and	3	0	0	3

		application				
U18PEBT062	Medical Biotechnology	Biopharmaceutical Technology	3	0	0	3
U18PEBT063	Environmental biotechnology	Bioremediation Technology	3	0	0	3

OPEN ELECTIVE OFFERED BY THE DEPARTMENT OF IBT					
U18OEBT001	Chemical Process Industries	3	0	0	3
U18OEBT002	Bioprocess Economics & Plant Design	3	0	0	3
U18OEBT003	Brewing technology	3	0	0	3
U18OEBT004	Biomining	3	0	0	3
U18OEBT005	Industrial Safety Engineering	3	0	0	3
U18OEBT006	Biodiversity Management	3	0	0	3

LIST OF COURSES

LIST OF HUMANITY AND SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	3	2	1	0	3
3	U18HSBA502	HS	Organizational behaviour	3	3	0	0	3
4	U18HSBT601	HS	Bio entrepreneurship Development	3	3	0	0	3
TOTAL CREDITS								**12**

LIST OF BASIC SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	3	1	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
5	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
6	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	3	1	0	4
7	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
8	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
9	U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
10	U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
11	U18BSMA305	BS	Transforms and Numerical Methods	4	3	1	0	4
12	U18BSMA501	BS	Statistics for Bio Science	4	3	0	0	3
TOTAL CREDITS								**30**

LIST OF ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18ESCS1L1	ES	Problem Solving and Python ProgrammingLab	3	0	0	3	1.5
4	U18ESGE201	ES	Cytology and Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
7	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
TOTAL CREDITS								**17**

LIST OF PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18PCBT301	PC	Introduction to Molecular biology	2	2	0	0	2
2	U18PCBT302	PC	Principles of Chemical Engineering	3	2	1	0	3
3	U18PCBT303	PC	Biochemistry	3	3	0	0	3
4	U18PCBT304	PC	Microbiology	3	3	0	0	3
5	U18PCBT305	PC	Instrumentation for Biotechnology	2	2	0	0	2
6	U18PCBT3L1	PC	Biochemistry Lab I	2	0	0	2	1
7	U18PCBT3L2	PC	Cell Biology Lab	2	0	0	2	1
8	U18PCBT401	PC	Plant Biotechnology	3	3	0	0	3
9	U18PCBT402	PC	Principles of Chemical Thermodynamics	3	2	1	0	3

10	U18PCBT403	PC	Unit Operations	3	2	1	0	3
11	U18PCBT404	PC	Introduction to Industrial Biotechnology	2	2	0	0	2
12	U18PCBT405	PC	Bioorganic chemistry	2	2	0	0	2
13	U18PCBT406	PC	Immunology	3	3	0	0	3
14	U18PCBT407	PC	Recombinant DNA Technology	3	3	0	0	3
15	U18PCBT4L1	PC	Microbiology Lab	2	0	0	2	1
16	U18PCBT4L2	PC	Biochemistry Lab - II	2	0	0	2	1
17	U18PCBT501	PC	Principles of Bioprocess Technology	3	2	1	0	3
18	U18PCBT502	PC	Chemical Reaction Engineering	3	2	1	0	3
19	U18PCBT5L1	PC	Molecular biology & Genetic Engineering Lab	2	0	0	2	1
20	U18PCBT5L2	PC	Chemical Engineering lab	2	0	0	2	1
21	U18PCBT601	PC	Animal Biotechnology	2	2	0	0	2
22	U18PCBT602	PC	Enzyme Engineering and Technology	3	2	1	0	3
23	U18PCBT603	PC	Bioprocess Engineering	3	2	1	0	3
24	U18PCBT6L1	PC	Bioprocess Engineering Lab I	2	0	0	2	1
25	U18PCBT6L2	PC	Plant and Animal Biotechnology Lab	2	0	0	2	1
26	U18PCBT6L3	PC	Immunology Lab	2	0	0	2	1
27	U18PCBT701	PC	Down Stream processing	3	3	0	0	3
28	UI8PCBT702	PC	Research methodology and Instrumentation	2	2	0	0	2
27	U18PCBT703	PC	Nanobiotechnology	3	3	0	0	3
29	U18PCBT7L1	PC	Bioprocess Engineering Lab II	2	0	0	2	1
30	U18PCBT7L2	PC	Downstream processing Lab	2	0	0	2	1
TOTAL CREDITS								**65**

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18EEBT5C1	EE	Comprehension - I	0	0	0	0	1
2	U18EEBT7P1	EE	Project I	6	0	0	6	3
3	U18EEBT7I1	EE	Internship (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
4	U18EEBT8C2	EE	Comprehension – II	0	0	0	0	1
5	U18EEBT8P2	EE	Project II	18	0	0	18	9
TOTAL CREDITS								**15**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I						
COURSE CODE	**SPECIALISATION**	**COURSE NAME**	**L**	**T**	**P**	**C**
U18PEBT011	Food Processing Technology	Food science and nutrition	3	0	0	3
U18PEBT012	Medical Biotechnology	Medical biotechnology	3	0	0	3
U18PEBT013	Environmental biotechnology	Environmental Biotechnology	3	0	0	3
PROFESSIONAL ELECTIVE II						
U18PEBT021	Food Processing Technology	Dairy Technology	3	0	0	3
U18PEBT022	Medical Biotechnology	Cancer biology	3	0	0	3
U18PEBT023	Environmental biotechnology	Fertilizer Technology	3	0	0	3
PROFESSIONAL ELECTIVE III						
U18PEBT031	Food Processing Technology	Food Process Technology	3	0	0	3
U18PEBT032	Medical Biotechnology	Proteogenomics and Bioinformatics	3	0	0	3
U18PEBT033	Environmental biotechnology	Waste Management Technology	3	0	0	3
PROFESSIONAL ELECTIVE IV						
U18PEBT041	Food Processing Technology	Food safety and Quality control	3	0	0	3

U18PEBT042	Medical Biotechnology	Stem cell and Tissue Engineering	3	0	0	3
U18PEBT043	Environmental biotechnology	Biofuel Technology	3	0	0	3
PROFESSIONAL ELECTIVE V						
U18PEBT051	Food Processing Technology	Bioreactor design	3	0	0	3
U18PEBT052	Medical Biotechnology	Developmental Biology	3	0	0	3
U18PEBT053	Environmental biotechnology	Industrial waste treatment and disposal	3	0	0	3
PROFESSIONAL ELECTIVE VI						
U18PEBT061	Food Processing Technology	Fermentation technology and application	3	0	0	3
U18PEBT062	Medical Biotechnology	Biopharmaceutical Technology	3	0	0	3
U18PEBT063	Environmental biotechnology	Bioremediation Technology	3	0	0	3

LIST OF MANDATORY COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
2	18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	U18MCAB203	MC	Yoga	2	0	0	2	0
4	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
8	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
9	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
10	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness	2	0	0	2	0

			&Meditation					
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
13	U18MCTH603	MC	Essence of Indian knowledge Tradition	2	2	0	0	0
14	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
15	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
16	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
17	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
18	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL CONTACT PERIODS				**36**				

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	**Humanities & Social Sciences (HS)**	3	3			3	3			12	**7.14**
2	**Basic Sciences (BS)**	10	13	4		3				30	**17.86**
3	**Engineering Sciences (ES)**	7.5	9.5							17	**10.12**
4	**Professional Core (PC)**			15	21	8	11	10		65	**38.69**
5	**Professional Electives (PE)**					6	3	6	3	18	**10.71**
6	**Open Electives (OE)**						3	3	5	11	**6.55**
7	**Project Work, Seminar, Internship, Term Paper, etc. (EE)**					1		4	10	15	**8.93**
	Total Credit	20.5	25.5	19	21	21	20	23	18	168	**100**
	Total Contact Hour	**35**	**36**	**25**	**29**	**29**	**29**	**31**	**28**	**242**	

	COMMUNICATIVE ENGLISH	**L**	**T**	**P**	**C**
U18HSEN101	Total Contact Periods – 45	2	0	2	3

	Prerequisite – School English
	Course Designed by – Department of English
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 15

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)

6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. **Practical English Usage. Michael Swan. OUP. 2005.**
6. **Remedial English Grammar. F.T. Wood. Macmillan.2007**
7. **On Writing Well. William Zinsser. Harper Resource Book. 2001**

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

MAPPING BETWEEN COURSE OUTCOMES&PROGRAMME OUTCOMES

COs\POs	a	b	c	d	e	f	g	h	i	j	k	l
1	S										S	
2		M							M			
3			S							S		S
4				S		M						
5					S		S	W				

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA102	**Mathematics I for Bio Engineering**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The aim is to develop mathematical curiosity and use inductive and deductive reasoning when solving problems, and to develop the knowledge, skills and attitudes necessary to pursue further studies in				

	Mathematics and to become confident in using Mathematics to analyze and solve problems in real – life situations.

UNIT I THEORY OF EQUATIONS (9+3)

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3)

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., ManickavachagamPillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

	COURSE OUTCOMES (COs)
CO1	Solve the equations (such as linear, factorable, quadratic and rational), applications and linear inequalities, to know the formation of equations.
CO2	Use both the limit definition and rules of differentiation to differentiate functions.The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions

CO4	Compute definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gamma
CO5	Identify Eigen value problems from practical areas using transformations;

CO/PO Mapping:S – Strong, M – Medium, W – Weak												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			W	M							
CO2	S				M		W			W		
CO3	S				M				W			W
CO4	S		S	W	M			M				
CO5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	**Waves and Optics**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)													
CO1	Understand the basic concept of waves and lights												
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing												
CO3	Understand the propagation of light and geometrical optics												
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves												
CO5	Understand the concept of laser and its applications												
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	M			M	S	S		S
	CO2	W	S	M	M	S			M		W	S	
	CO3	S	W			W			M	M		M	M
	CO4	S	W			W			M	M		M	
	CO5	S	M	M	M				M		S	W	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis.NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2002).

2. S.S.Dara “A text book of Engineering Chemistry” S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			M		S		S		W		
CO2		W	S		M		S		M		W	
CO3		M		S		W				M		M
CO4	S		M	W			M			S		
CO5		S		W		M				S		S
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING **9**

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks

of algorithms (statements, state, control flow, functions), notation (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr,―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems

CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	S	M	S	M	W		M	W	M	S
	CO2	S	S	M	M		M		W			M	
	CO3	M	M	W	S	M		W		W		M	M
	CO4	M	M	W	M	S	M	W	M	W		M	
	CO5	M	S	W	M	M			M	M	W		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet des needs, using the techniques, skills, and modern engineering tools necessary engineering practice				

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypocycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of Points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE 4:SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple Position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students willgetExposure to basics of building construction

CO4	Students willgetExposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S			M			S					
	CO2	S	S	W		S	M						S
	CO3			S									
	CO4											S	M
	CO5	S						W					
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	S	M	M	M	M		M	
	CO2	S	S	W	S	S	M	W	M	M	M	M	M
	CO3	S	S	M	M	M	M		M	M	M	M	
	CO4	S	M	S	S	S	M	M	M	M	W		
	CO5	S	S	M	S	M	M		M	M	W	M	S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSPH2L3	**Wave Optics and Bio Physics Laboratory (Common to B.Tech- IBT, GE &Agri Bio Tech)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Wave Optics and Bio Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Biophysics – Bio-Engineering branches

1. Determination of optical rotation using polarimeter
2. Determination of diffusion potential of biological sample
3. Analysis of viscosity of different biological sample using viscometer
4. Analysis of protein concentration using calorimeter
5. Quantification of DNA using UV-Vis spectrophotometer
6. Analysis of absorption maxima for an unknown sample

Course Outcome (CO's)	
CO1	Understand the fundamental concept of optics

CO2	Understand the concept of production of ultrasonic waves												
CO3	Understand the estimation and functions of Biomolecules												
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S		S	S				S	W	M		S
	CO2	S	S	W					S	W	M		
	CO3				S				S	M	W		M
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base andConductometric Precipitation titration.

CO4	Student will be able to analyze Determination of Molecular weight of a Polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COs WITH POs: S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S		M	M		S		S		W		
CO2	W	S			M		S		M		W	S
CO3		M		M						M		
CO4	S		M				M				S	M
CO5		S		W		M				S		

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				

OBJECTIVES

To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a

meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology.OrientBlackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

Upon completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	a	b	c	d	e	f	g	h	i	j	k	l
1	M										S	
2		S							M			
3			S							S		S
4				M		S						
5					M		M	W				

Category	Basic Science (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

	Mathematics II for Bio Engineering (Common to IBT, Genetics and Agricultural Bio Tech)	**L**	**T**	**P**	**C**
U18BSMA202	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	To make the students learn Mathematics in order to formulate and solve problems effectively in their respective fields of engineering.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Integration of vector function - Green's theorem in a plane – Gauss divergence theorem and Stoke's theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions,Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO3	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO4	To understand the analytic functions, conformal mapping and complex integration

	and their applications.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping:S – Strong, M – Medium, W – Weak												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO	M		W		S				M		S	
CO	S	M			S				W			
CO	S	M			S			M		W		S
CO	S		W				M		S			
CO	S		W	W			M				S	
Cat	Basic Science (BS)											
App	47th Meeting of the Academic Council Meeting held in Aug, 2018											

U18BSPH203	**INTRODUCTION TO BIOPHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES:

To impart theories and methods of Physics to understand the functioning of Biological system

UNIT 1 ATOMIC PHYSICS **9**

Atom model - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - spatial quantisation - Bohr magneton - Stern and Gerlach experiment.

UNIT 2 NUCLEAR PHYSICS **9**

Nuclear size, shapes and forces: Nuclear size determination - Electron scattering method-electric moments - magnetic moments - Nuclear forces - Models of nuclei – Liquid drop model of nuclei- Atomic masses and its significance.

UNIT 3 RADIATION BIOPHYSICS **9**

Basics of Radiation Physics Atomic structure models, Constituents of atomic nuclei, Isotopes, Isobars, Isotones, Radioactivity, law of Radioactivity, General properties of alpha, beta and gamma radiations, Radiation units: Units of measurement of radioactivity. Curie, Becquerel., Interaction of radiation with matter: Excitation and ionization, Photo electric effect, Compton Effect, pair production, Characteristic radiation.

UNIT 4 MEMBRANE BIOPHYSICS **9**

Membrane potentials Cell surface charge, Resting membrane potential, Action potential, Ionic transport during Action Potential, properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, total electrochemical potential.

UNIT 5 MOLECULAR BIOPHYSICS 9

Nucleic acids – Purine and Pyrimidine bases, nucleosides, nucleotides basic difference in structures and functions of DNA and RNA

Proteins– Amino acids – types, planarity of peptide bond – Ramachandran map - Primary, secondary, tertiary and quarternary structures of proteins.

REFERENCE BOOKS:

1. R.Murugeshan and KrithigaSivaprasath, "Modern Physics", S.Chand publisher, 2016 (for Unit 1& 2)
2. Brij and Subramanian, "Atomic and Nuclear Physics" , S.Chand publisher, 2008 (for Unit 1 & 2)
3. JB Rajam, "Atomic Physics", 7th Edition, S.Chand publisher, 2005 (for Unit 1)
4. M.Volkenstein "General Biophysics" 1st Edition, Academic press, 1983 (for Unit 4)
5. Voet and Voet, "Introduction to Biochemistry" , 5th Edition, John Wiley & sons Inc., 2016 (for Unit 5)
6. Branden and Tooze, "Introduction to Protein Structure"2nd edition, Garland publishing, 1999
7. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014

Course Outcome (COs)													
CO1	Understand the fundamental concept of Atomic Physics												
CO2	Understand the basic concept of Nuclear Physics												
CO3	Understand the Radiation Physics and its measurement												
CO4	Understand the Membrane Biophysics with functions of different potentials												
CO5	Understand the Structural and molecular Biophysics												
Mapping of Course Outcomes with Programme Outcomes, S – Strong, M – Medium, W – Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	W	W	W					S	W	M		
	CO2	W	W	W					S	W	M		S
	CO3	W	W	W					S	W	M		
	CO4	W	W	W					S	W	M		M
	CO5				M				S	W	W		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSGE201	**CYTOLOGY AND GENETICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES: To provide a basic understanding of cell, its structure, function, types and about its culture					

UNIT I CELL STRUCTURE AND ORGANELLES 6

Cells - definition - eukaryotic cell and prokaryotic cell- Relationship and evolution of eukaryotic cell and prokaryotic cell- plant cells and animal cells - Cell Organelles, Structure and function – Nucleus- Endoplasmic reticulum - Golgi complex- lysosomes- cell membranes- chloroplast- mitochondria.Cell cycle-Mitosis and meiosis

UNIT II CELLULAR TRANSPORT 6

Transport across cell membranes – classification – Active and passive transport. Active – Na+ K+ ATPase Pump - Lysosomal and Vacuolar pumps - Endocytosis and Exocytosis transport across prokaryotic membrane - Cotransport–Symport, antiport.

UNIT III CELL SIGNALING AND SIGNAL TRANSDUCTION 6

Cell signaling – various kinds of Receptors and ligands –Different modes of action of ligands- different modes of signal transduction and amplification with examples- signaling through G-Proteins (Monomeric and trimeric), signaling for growth factors- secondary messengers- protein kinases- Caions and cAMP molecule in signaling.

UNIT IV BASICS OF GENETICS AND CHROMOSOMES 6

Mendelian Laws - Mendel's experiment - monohybrid cross-phenotype – genotype - Dihybrid inheritance - Chromosome structure and organization in prokaryotes and eukaryotes - chromosome banding - chromosome abnormalities

UNIT V ALLELES 6

Classical concepts of Pleomorphism - Multiple alleles, ABO blood groups - Rh factor - sex linkage in Drosophila- mechanism of sex determination- sex differentiation

TEXT BOOKS:

1. The Cell, Geoffrey M. Cooper & Robert E. Housman, Sinauer Associates Inc, 2015.
2. Genetics, Monroe W. Strickberger, Pearson Education India, 2015.

REFERENCE BOOKS:

1. Molecular Biology of the Cell, John Wilson and Tim Hunt, Garland science, 2014.
2. Cell Biology and Histology, Leslie P.Gartner and James L.Hiatt, Wolters Kluwer, 2014.
3. Principles of Genetics, Eldon John Gardener et al., Wiley publications, 2006.

COURSE OUTCOMES (COs)	
CO1	To understand the fundamentals of the structure of cells
CO2	To study the types and functions of cell organelles
CO3	To comprehend the methods involved in the cellular transport
CO4	To know the cause, and methods of cell signaling
CO5	To give a basic knowledge of cell culture and its applications
CO6	To understand about signal transduction

Mapping of Course Outcomes with Program outcomes (POs)
S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S					M	M	S				
	CO2	S			M			M		M			M
	CO3	M	M								M		
	CO4	S		M				S				M	S
	CO5	S					M					S	

	CO6	S			S				S		M		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition. 2017.
2. SmarajitGhosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2011.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition, 2015.
6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.

7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W- Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	W			M				S		W	
	CO2	S	W			M				S		W	W
	CO3	S	M			M				S		W	
	CO4	S	W			M				S		W	M
	CO5	S	W			M				S		W	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION **9**

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION **9**

Definition, Causes, effects and control measures of Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION **9**

Social issues: Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel – oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: Population growth, variation among nations, population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.

3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			M		S		S		W		
CO2	W	S	S		M		S		M		W	M
CO3		M				W			S	M		
CO4	S		M	W			M				M	W
CO5		S		W		M				S		

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESME1L2	**WORKSHOP/MANUFACTURING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenonjoints.
   c) Cross Half joints.
   d) Dove Tail joints.

1. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

2. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

3. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											S	
	CO2			S	M							S	
	CO3		M										S
	CO4	S			W							S	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers

3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipments and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flops

Mappingof Course Outcomes (COs) with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S- Strong, M-Medium, W- Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S			S				S		M	
	CO2	S	S			S				S		M	W
	CO3	S	S			S				S		M	
	CO4	S	S			S				S		M	M
	CO5	S	S			S				S		M	
	CO6	S	S			S				S		M	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCBT301	**INTRODUCTION TO MOLECULAR BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Basic concepts in Biology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of molecular level of DNA and their applications from the perspective of engineers

UNIT I DNA STRUCTURE 6

DNA as the vehicle of inheritance-structure of DNA-forms of DNA-nucleic acid biosynthesis-experimental evidence: Griffith, McLeod, McCarty and Avery, Hershey–Chase experiments-Definition of gene-organization of genes and non coding DNA in prokaryotes- Eukaryotes–

unique, moderately repetitive and highly repetitive DNA sequence-satellite DNA- Cot value-DNA binding proteins

UNIT II DNA REPLICATION 6

DNA replication in prokaryotes and eukaryotes- modes of replication-semi continuous and semi discontinuous replication- Okazaki fragments- RNA primers – enzymes of replication – DNA polymerases I, II, III, -DNA modifying enzymes: topoisomerases-helicases- binding proteins and ligases- replication in E.coli–replisomes-events at OriC (initiation), events on the replication fork (elongation) and termination- Fidelity of replication-Sigma or rolling circle mode of replication in Φ x 174-Inhibitors of replication.

UNIT III DNA REPAIR 6

Repair of DNA–types of damages- repair by direct reversal of damage- excision repair-recombination repair- SOS repair-Mutation: definition-type of mutations (spontaneous and induced) point mutation-Gene mutation and chromosomal aberrations- Cause of mutations-chemical and physical agent

UNIT IV TRANSCRIPTION 6

Transcription in prokaryotes and eukaryotes: RNA polymerases–enzyme structure- role of sigma factor- promoter-closed and open promoter complexes-Initiation-elongation and termination of RNA synthesis-Post transcriptional modification in prokaryotes and eukaryotes-transcription factors

UNIT V GENETIC CODE 6

Genetic code–Basic features of genetic code-Deciphering of genetic code-Wobble hypothesis-Protein biosynthesis-activation of amino acids- initiation-elongation and termination of translation in prokaryotes and eukaryotes-Post translational modifications-Inhibitors of translation.-Regulation of gene expression in prokaryotes and eukaryotes- operon concept

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of central dogma of biological systems												
CO2	to know the concept of cell replication, transcription and translation												
CO3	to comprehend DNA and its role in functioning of a cell												
CO4	to know the functioning of regulatory factors and its application in maintaining cell activity												
CO5	to get a basic knowledge of the DNA and RNA												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	H				H				H	H
	CO2	H			H		H						
	CO3	H	M			H		H	H		M		
	CO4	H	M									H	
	CO5	H					H			H			
3	Category	PC											

4	Approval	Academic Council, Aug 2018

TEXT BOOKS

1. Biochemistry by Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2006
2. Lehninger, Principles of Biochemistry, David L. Nelson and Michael M. Cox, 2008
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann, Molecular Biology of the Gene (6th ed), 2007

REFERENCE BOOKS

1. R.L. Adams, J.T. Knowler, and D.P. Leader, The Biochemistry of the Nucleic Acids, 1992
2. Stephen Neidle, Principles of Nucleic Acid Structure, 2007
3. Robert Weaver, Molecular Biology, 2007
4. Weblink: nptel

U18PCBT302	**PRINCIPLES OF CHEMICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics -II, basics about unit operations				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of Process engineering

UNITI BASIC STOICHIOMETRY 9

Basic stoichiomentric calculations: mole, molar mass, normality, molarity, molality, mole fraction, mass fraction, Ideal gas law, Raoult's law, Average molecular weight.

UNIT II MATERIAL BALANCES 9

Unit operation & Process - Law of conservation of mass – material balances without reaction: drying, evaporation, distillation, extraction, mixing, Material balances with chemical reactions: limiting and excess reactant-conversion -Yield – Selectivity.

UNIT III ENERGY BALANCES 9

Energy - Forms of energy- Energy balances –Heat capacity- heat capacity of gases and liquids- heat capacity of gaseous mixtures -Latent heat and sensible heat- Hess's law- Standard heat of Reactions.

UNIT IV FLUID MECHANICS 9

Fluids –Types of fluid - Nature of flow – Derivation of Bernoullis equation - Flow meters: Manometers - types of manometers —Venturi meter and orifice meter.

UNITVAGITATION AND TRANSPORTATION OF FLUIDS 9

Mixing and Agitation –Agitation equipment- Impellers and types - Prevention of swirling - Power requirement for mixing – Pumps: single acting and double acting pump -Work of consumption.

COURSE OUTCOMES (COs)	
CO1	to understand the various unit operations involved in industry
CO2	to know the material balance for a process.

CO3	to know the energy balance for a process.
CO4	to get an idea about fluid mechanics.
CO5	to know about agitation and the types of agitators

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H								
	CO3	H				H		M					M
	CO4	H	M		H	H							
	CO5	H	M	M		H		M					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.A.Gavhane, 2009, "Introduction to process calculations Stoichiometry" NiraliPrakasham Publications 22nd.

REFERENCE BOOKS

1. K.A. Gavhane, 2009, "Fundamentals of chemical engineering" NiraliPrakasham Publications 22nd.
2. McCabe and Smith,2002, "Unit operations in Chemical Enginering", Tata McHraw Hill Pblications, 6th Ed.
3. K.A. Gavhane, 2009, "Unit operations I Fluid flow & Mechanical operations" NiraliPrakasham Publications, 17th.
4. Bhat& Vora,2001, 'Stoichiometry", Tata McGraw Hill Ltd, III Ed.
5. Weblink: nptel

	BIOCHEMISTRY	**L**	**T**	**P**	**C**
U18PCBT303	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Chemistry and Biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge about biomolecules

UNIT I CARBOHYDRATES 9

Significance and classification of carbohydrates – Structure and properties of monosaccharides: glucose, fructose, galactose; oligosaccharides: sucrose, lactose, maltose, raffinose; polysaccharides: storage, structural, homo, hetero polysaccharides – starch, cellulose, hyaluronic acid.

UNIT II LIPIDS 9

Fatty acids: Structure, properties and classification – Lipids – Classification – Structure and functional properties of phospholipids,sphingolipids, glycolipids and steroids.

UNIT III PROTEINS 9

Structure and properties of aminoacids – classification based on side chains and nutritional requirements – Peptides: Chemistry and its significance – Proteins: Various levels of structures – n classification based on composition and function.

UNIT IV NUCLEIC ACIDS 9

Structure of purine and pyrimidine bases – Nucleosides – Nucleotides – Watson-crick model of DNA – various levels of organization of DNA – superhelical DNA – Structure and functions of mRNA, tRNA and rRNA.

UNIT V METABOLISM 9

Metabolism – Glycolysis, TCA cycle and Hexose Mono Phosphate pathway;Biosynthesis and β oxidation offattyacids.Biosynthesis of aromatic amino acid and catabolism of amino acids: Urea cycle– Biosynthesis and degradation of purines and pyrimidines.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of biomolecules, their classification, structure												
CO2	to apply the basic concept of carbohydrates, proteins ,lipids, nucleicacids and enzymes in metabolism.												
CO3	to know the application of biomolecules in functioning of biological system												
CO4	to get a basic knowledge of macromolecules in living organism and its energetic												
CO5	To know basic concepts of enzymes												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M				H						L
	CO2								H			H	
	CO3	H		H		H				H	H		H
	CO4	H	M				H	H					
	CO5	H										H	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. 'Gaw A, 2008, "Clinical biochemistry" Elsevier Health Sciences, 4th.Ed.
2. J.L. Jain, 2008, "Fundamentals of biochemistry" S. Chand.8th Ed

REFERENCE BOOKS

1. J.L. Jain , , 2007 ,"Text Book Of Biochemistry' ,14th Ed
2. Zubey 2004 "Biochemistry" III Ed,

3. Voet&Voet 2006, “Biochemistry” V ed,.
4. Lehninger Nelson & Cox , , 2005 “Principles of Biochemistry”,4th Ed
5. Weblink: nptel

U18PCBT304	**MICROBIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic concepts in biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of microbes and their applications from the perspective of engineers

UNIT I INTRODUCTION TO MICROBIOLOGY 9

Definition-Scope and history of microbiology-prokaryotic and eukaryotic cell- different types of classification-Nomenclature-fermentation-pasteurization-role of microorganisms in pharmaceutical, food, agro and cosmetic industries-bioremedial applications-illustrations of genetically engineered strains

UNIT II GENERAL FEATURES OF MICROORGANISMS 9

Bacteria: diversity-classification-morphology-life cycle-Fungi: diversity-classification-morphology-life cycle-Algae: diversity-classification-morphology-life cycle-virus: diversity-classification-morphology-life cycle

UNIT III MICROSCOPY 9

Introduction- numerical aperture, resolving power-magnification- fixation, dyes and simple staining, differential staining- gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining-simple-compound-dark field-phase contrast-polarizing-fluorescent-laser optics-electron microscopy-scanning electron microscope-transmission electron microscope, specimen preparation-inverted microscope

UNIT IV MICROBIAL NUTRITION AND GROWTH 9

Common nutrient requirements-nutritional types of microorganisms, growth factors-uptake of nutrients by cells- culture media: synthetic or defined media-commonly used media-Types of media-selective-differential-enrichment media-aseptic techniques: disinfection-sterilization-cultivation of microbes: bacteria-fungi-viruses-pure culture: concept of pure culture-methods of pure culture of microorganisms–spread plate, streak plate and pour plate–microbial growth curve-factors affecting growth of microorganisms-measurement of growth

UNIT V MICROBIAL PATHOGENS AND DISEASES 9

Bacterial pathogens: *Staphylococcus aureus*-*Enterobacteriaceae*-Shigellosis-Fungal pathogens: superficial mycosis: -candidiasis- Mycetoma-subcutaneous phycomycosis: Cryptococcosis-opportunistic systemic mycosis-mycotic poisons-Viral pathogens: Pox virus, AIDS virus, influenza virus.

COURSE OUTCOMES (COs)

CO1	to understand the source of microbes and their role in biotechnology												
CO2	to get the knowledge of microbial diversity classification and morphology												
CO3	to know the visualization of microbes by different microscopes												
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens												
CO5	to get a basic knowledge of the microbial nutrition and growth												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M			H	H	H	H		H
	CO2	H		M									
	CO3	H						H		H			H
	CO4	H		M	M			H					
	CO5	H				H	H						
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg, 2005, "Microbiology " TATA McGraw Hill, 5thed
2. Anantha Narayan, C.K. JayaramPaniker, 2009, "Text Book of Microbiology" Orient Blackswan, 7thed

REFERENCE BOOKS

1. Presscott and Dunn, 2006, "Industrial Microbiology" CBS Publishers& Distributors.
2. Daniel V.Lim, "Microbiology", Kendall Hunt, 2002 ed
3. Weblink: nptel

U18PCBT305	**INSTRUMENTATION FOR BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – basic principles in instrumentation				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES To provide a basic knowledge of the working principle of instruments and their applications from the perspective of engineers					

UNIT I RADIATION TECHNIQUES 6

Sources of radiation- absorptivity-Lambert Beers law, deviations, detectors, photometric accuracy, Rayleigh scattering, Fourier transform, calibration and standardization, atomisation, flame atomisation, turbidimetric and nephlometric titrations -scattering in gases.

UNIT II ELECTROCHEMICAL TECHNIQUES 6

Principles: redox potential-pH electrode-ion selective and gas sensing electrodes-Clarke oxygen electrode and its application-biosensors.

UNIT III SPECTROSCOPIC TECHNIQUES 6

Colorimetry-UV-visible spectrophotometry-ORD-CD-X-ray spectroscopy-IR spectroscopy-ESR spectroscopy-NMR spectroscopy-Mass spectroscopy

UNIT IV SEDIMENTATION TECHNIQUES 6

Centrifugation principles-centrifuges and its types-differential and density gradient centrifugation-analysis of subcellular fractions-assessment of purity and determination of relative molecular mass

UNITV RADIOISOTOPE TECHNIQUES 6

Nature of radioactivity-Detection and measurement of radioactivity-GM counter-Scintillation counting-photographic emulsions-radiotracer techniques-autoradiography

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of instruments and their different mode of applications												
CO2	to know the principle, working concept and its applications												
CO3	to find the various laboratory work based on instruments												
CO4	to know the different types of instruments based on various parameters												
CO5	to get a basic knowledge of equipments and their role in biological systems in relevant industries												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H				H					
	CO2	H	H	H	H					H		H	
	CO3	H						H					
	CO4	H						H			M		
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Willard and Merrit, "Instrumental Methods of Analysis", VI Edition, CBS Publishers and Distributors.
2. Asokan, Practical Biochemistry, IV edition

REFERENCE BOOKS

1. Ewing GW, "Instrumental Methods of Chemical Analysis", McGraw Hill Book Company, 1989.
2. Braun H., "Introduction to Chemical Analysis", McGraw Hill, 1987.
3. Keith Wilson and Walker, Practical Biochemistry, V edition, Cambridge editions.

U18BSMA305	TRANSFORMS AND NUMERICAL METHODS	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Mathematics I & II				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.

UNIT I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORMS **12** Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 12

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan ,Jacobian and Gauss-Siedel methods.

UNIT IV FINITE DIFFERENCES AND INTERPOLATION **12**

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT V NUMERICAL DIFFERNTIATION AND INTEGRATION **12**

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications.
CO3	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO4	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO5	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			H					M			
	CO2	H			H			M	M				
	CO3		M		M								L
	CO4		M		M					M			L
	CO5		M					L		L			
3	Category	BS											

4	Approval	Academic Council, Aug 2018

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5th edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. Curtis F.Gerald. "Applied Numerical Analysis" 7thEdn. Pearson Education.
3. Dennis G.Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jo& Bartlett Publishers, UK. 1992
4. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company, 2nd Edition 2010.
5. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications(reprint),2006.

	BIOCHEMISTRY LAB I	**L**	**T**	**P**	**C**
U18PCBT3L1	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Basic concepts in chemistry and biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of biochemical components and its functions and their Applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Preparation of normal, molar and percent solutions.
2. Preparation of different buffer solution and measure pH.
3. Qualitative analysis of Unknown sugar- Monosaccharides,disaccharides and polysaccharides.
4. Estimation of sugar- Benedicts method.
5. Qualitative of unknown protein- Albumin,casein and gelatin.
6. Quantitative test for aminoacids- Ninhydrin method.
7. Quantitative test for protein – Biuret method.
8. Quantitative test for protein –Lowry method.
9. Quantitative test for protein – Bradford method
10. Spectrophotometric analysis of DNA.

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COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biomolecules, their classification,structure and functions
CO2	to apply the basic concept of carbohydrates, proteins,lipids, nucleicacids and enzymes in metabolism

CO3	to know the application of biomolecules in functioning of biological system
CO4	to get a basic knowledge of macromolecules in living organism and its energetics
CO5	To know basic concepts of enzymes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H					H			H	H	L
	CO2	H				M		H			H	H	
	CO3		H	M				H	L			H	
	CO4	H	H					H			H	H	
	CO5	H					M	H			H	H	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT3L2	**CELL BIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – basic cell biology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge about cell biology					

LIST OF EXPERIMENTS

1. Study of Microscope
2. Spotters
3. Permanent Slide preparation
4. Killing and Fixing
5. Mitosis on onion root tip
6. Cryopreservation
7. Preparation of Blood smear
8. Separation of plasma and serum from blood sample
9. Total RBC and WBC Count
10. Osmosis
11. Extraction of pigments

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of instruments and their different mode of applications
CO2	to get idea about slide preparation
CO3	to know about blood grouping
CO4	to get knowledge about mitosis
CO5	to get a basic knowledge of extraction of plant pigments

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H	H			H					
	CO2	H	H					H	M				
	CO3	H			H	H	H	H					

	CO4	H						H					
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB305 Learning an Art Form **0 0 2 0**

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306Intangible Cultural Heritage (Festivals, Food ways, Local Games) 0 0 2 0

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

To study and document the prevalent social practices and beliefs regarding traditional foods;

To study and document the feasts on religious and social occasions of different communities;
To identify and document the food items consumed by different communities and determine their nutritional values;
To conduct chemical analysis of food ingredients;

To identify and document the kitchen generated health ingredients used by different communities;
To find out the uses of leftover food stuff of different communities;

To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and
To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

U18PCBT401	**PLANT BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – General biology, Cell biology, Microbiology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge about plant tissue culture and its applications					

UNIT I PLANT MOLECULAR BIOLOGY 9

Plant genome organization – mitochondrial genome – cytoplasmic male sterility – chloroplast genome – post transcriptional and translational modifications – transcription factors – gene silencing – regulation of gene expression – transposable elements

UNIT II PLANT GENETIC ENGINEERING 9

Vectors: viral vectors –Ti plasmid vectors – promoters– methods of gene transfer:direct and indirect-biolostics-Agrobacterium mediated gene transfer–newer methods of gene transfer in plants– selection of transformants/recombinants – RFLP, RAPD – plant pathogen interactions.

UNIT III PLANT TISSUE CULTURE 9

Basic terminologies – requirements of a plant tissue culture laboratory – Types of culture – selection of explants – sterilization techniques – Types of media – direct and indirect regeneration – micropropagation – haploid culture – protoplast culture – somatic hybridization and cybridization – embryo rescue – artificial seeds.

UNIT IV BIOFERTILIZERS,BIOCONTROL AND BIOREMEDIATION 9

Biofertilizers and its applications: Rhizobium-BGA-Frankia-VAM-applications–biocontrol of insect pests–genetic engineering of biocontrol agents–Biopesticides-Bioremediation– effluent treatment and using plant materials (Phytoremediation).

UNIT V APPLICATIONS 9

Transgenic plants for insect, disease, stress & herbicide resistance – edible vaccines and antibodies – methods of crop improvement through genetic engineering - DNA finger printing – production of secondary plant metabolites through suspension cultures.

COURSE OUTCOMES (COs)													
CO1	to understand basic concepts in organization of plant genome												
CO2	to know about the genetic engineering concepts involved in plant												
CO3	to know about plant tissue culture												
CO4	Toknow about bioremediation.												
CO5	to understand the various applications of plant tissue culture												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	L	L	H
	CO2	H	M	M	H		H	M	H	H	M	H	H
	CO3	H			H	H	H	M	M	M	L	L	M
	CO4	H	M	H		H	M	M	L		L	M	H
	CO5	H	M	M	H	H	M	M	M	M	H	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Adrian Slater, 2006, “Plant biotechnology”, 3rd Ed,

2. Fr. S. Ignacimuthu, 2000 Plant biotechnology IV ed.

REFERENCE BOOKS

1. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009," Plant Biotechnology"
2. Veereshem C, 2006, "Medicinal plant biotechnology" CBS Publishers & Distributors.

Weblink: nptel

U18PCBT402	**PRINCIPLES OF CHEMICAL THERMODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Basic concepts in chemical engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of thermodynamics					

UNITI BASIC CONCEPTS IN THERMODYNAMICS 9

Scope and limitations- Definitions and Fundamental concepts - Calculation of force, pressure and energy - Phase rule -Zeroth law- Heat reservoirs & Heat engine -First law- First law for non-flow process- enthalpy- First law for flow process.

UNIT II PVT BEHAVIOUR AND FIRST LAWOF THERMODYNAMICS 9

PVT behavior of pure liquids - Equations of state- Constant volume process , constant pressure process and constant temperature process- Vander Waals equation- Virial equation.

Second law- Mathematical statement of second law- Kelvin and Clausius statement- Clausius inequality

UNIT III THERMODYNAMIC PROPERTIES OF PURE LIQUIDS 9

Classification of properties- Helmholtz free energy - Gibb's free energy-Fundamental property relations- Maxwell equations - Clapeyron equation -Relationship between Cp and Cv- Fugacity and fugacity coefficient- Effect of temperature and pressure on fugacity- Activity and Activity coefficient-Effect of temperature and pressure on Activity.

UNIT IVCHEMICAL REACTION EQUILIBRIUM 9

Reaction stoichiometry -Equilibrium constant and standard free energy change - Effect of temperature on equilibrium constant- Evaluation of equilibrium constant - Effect of pressure on equilibrium - Other factors affecting equilibrium conversion.

UNITV APPLICATIONS OF THE LAWS OF THERMODNAMICS 9

Energy equation - Ejectors - Throttling process - Compressors - Adiabatic and Isothermal compression - Refrigeration - Choice of refrigerant -Absorption refrigeration- COP- Carnot cycle- Heat pumps.

COURSE OUTCOMES (COs)	
CO1	to understand the basic concepts in thermodynamics
CO2	to know the properties of fluid
CO3	to know to get an idea about application of thermodynamics in various field
CO4	to get knowledge about reaction equilibrium
CO5	to know about applications of thermodynamics law
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H				H	M				M
	CO2	H				L		H			H		
	CO3	H			L			H	H	H	H	H	
	CO4						L						L
	CO5	H	H		H			H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.V.Narayanan, 2004, "Chemical engineering thermo dynamics" Prentice Hall of India Pvt Ltd.

REFERENCCE BOOKS

1. K.A.Gavhane, 2009, "Chemical engineering thermodynamics" NiraliPrakasham Publications, 20th.
2. T.M.Letcher, 2004, "Chemical thermodynamics for industry" R.S.C Publication 3rd.

Weblink: nptel

U18PCBT403	UNIT OPERATIONS	L	T	P	C
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I& III, Principles of Chemical Engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To give a knowledge of heat and mass transfer					

UNIT IHEAT TRANSFER **9**

Modes of heat transfer- Derivation of Heat transfer through compound walland cylinder-Definition of Boiling, condensation and its types.

UNIT IIHEAT EXCHANGERS AND EVAPORATOR **9**

Heat exchanger- Theory of Shell and Tube heat exchanger and double pipe heat exchanger-Derivation of Overall heat transfer coefficient - LMTD.

Evaporator- Types: falling film- Climbing film. Forced circulation and Agitated film evaporator-Methods of feeding

UNIT IIIMASS TRANSFER **9**

Outline of Mass transfer operations- Derivation of Diffusion in Gases, Liquids & Solids. Distillation- Theory of Simple, Flash, Steam and Azeotropic distillation-McCabeThiele method

UNIT IVLEACHING **9**

Leaching- Theory of Moving bed leaching and Dispersed solid leaching. Liquid extraction- Mixer settler- Spray and packed extraction tower-Agitated extraction tower.

UNITVDRYING AND SIZE REDUCTION 9

Drying- Drying equipment: Tray, Screen-conveyor, Rotary and Spray dryer-Selection of drying equipment.

Size reduction -Laws- Work index-Size reduction equipment: Jaw crusher. Smooth roll crusher-Tumbling mill - Fluid energy mill - Knife cutters-open and Closed circuit operation

COURSE OUTCOMES (COs)													
CO1	to understand the basic concepts in heat transfer												
CO2	to know basic concepts of evaporation												
CO3	to know about mass transfer operations												
CO4	to know about leaching and extraction												
CO5	to know about various drying												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H				H		H		L	L		L
	CO2	H	H					H					
	CO3	H	H					H		M			M
	CO4		H	H	H						H	M	
	CO5	H			H			H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Gavahnee, 2009,"Heat & Mass Transfer" NiraliPrakasham Publications, 20th Ed

REFERENCE BOOKS

1. K.A. Gavhane, 2009, "Unit operations II Heat & Mass Transfer" NiraliPrakashamPyblications, 23rd Ed
2. G.S. Sawhney, 2008,"Heat & Mass Transfer" I.K. International Publishing House
3. McCabe W. L & Smith J. C., "Unit operations in chemical Engineering". V.Ed..McGrawHillInt Ed.,
4. Robert e.Treybal,2000, "Mass Transfer Operations", McGraw Hill International III edition.
5. Christie J. Geankoplis,2000 " Transport Processes and Unit Operations", Prentice Hall India PvtLtd, III Edtion,
6. Weblink: nptel

U18PCBT404	**INTRODUCTION TO INDUSTRIAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**

	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Basic cell biology, genetics and biology				
	Course Designed by – Dept. of Industrial Biotechnology				

UNIT I INTRODUCTION 6

Introduction to Industrial Biotechnology - Objectives and Scope of IBT - Characteristics and comparison of bioprocessing with chemical processing – Isolation, screening, preservation and improvement of industrial microorganisms

UNIT II PRODUCTION OF PRIMARY METABOLITES 6

Process Technology, Industrial production of primary metabolites: ethanol, acetone-butanol, citric acid, acetic acid (vinegar), L-glutamic acid, vitamin B_{12}

UNIT III PRODUCTION OF SEONDARY METABOLITES 6

Microbial production of secondary metabolites: penicillin, streptomycin, tetracyclines, carotenoids, riboflavin

UNIT IV PRODUCTION OF INDUTRIAL ENZYMES AND OTHER PRODUCTS 6

Microbial production of industrial enzymes - glucose isomerase, proteases- Mushroom culture – Biofertilizer: bacteria, cyanobacteria, mycorrhizal fungal inoculants – Micropesticides: bacterial, viral, mycopesticides

UNITV APPLICATIONS OF BIOTECHNOLOGY 6

Human health care products: insulin, human growth hormone, interferon, monoclonal antibodies- Development of vaccines for immunity

COURSE OUTCOMES (COs)													
CO1	to understand the objective and scope of biotechnology												
CO2	to know the concept of cell culture techniques												
CO3	to comprehend DNA and its role in functioning of a cell												
CO4	to know the microbial production												
CO5	to get an idea about the applications of biotechnology												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H	H				H
	CO2	H				H		H				H	
	CO3	H	H	H				H					
	CO4	H		H				H		H		H	M
	CO5	H								H	H	M	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK:

R.C. Dubey, ATextbook of Biotechnology, S. Chand & Company Ltd.

S.N. Joganand, 2003, "Environmental Biotechnology"Himalaya publishing House, IV ed.

REFERENCE BOOKS:

1. Saha BC,2003, “Fermentation biotechnology” Americal Chemical Society.
2. Vyas SP,2002, “Methods in biotechnology and bioengineering” CBS Publishers & Distributors.
3. Acharya R, 1999, “The emergence and growth of biotechnology” E.Elgar.
4. Jain PC, 2004, “Microbiology and biotechnology for sustainable development” CBS Publishers & Distributors.
5. Stanbury Whittaker, 2002, "Principles of fermentation technology" - II Edn.
6. Weblink: nptel

U18PCBT405	**BIOORGANIC CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Basics of biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biochemical reactions, mechanisms and their applications from the perspective of engineers

UNITI INTRODUCTION TO BIOORGANIC CHEMISTRY 6

Basic considerations, Proximity effect, Molecular adaptation, Molecular recognition, supramolecular chemistry, Chemistry of living cells, Analogy between biochemical transformations and bioorganic reactions.

UNIT II BIOORGANIC CHEMISTRY OF AMINO ACIDS AND PEPTIDES 6

Chemistry of Peptide bond synthesis- Asymmetric synthesis of amino acids - different models, Transition state analogous, chemical mutations, site specific mutagenesis, Molecular recognition and drug design, Catalytic antibodies.

UNIT III ENZYME CHEMISTRY 6

Introduction to enzymes, Types of enzymes- Immobilized enzyme- Semi synthetic enzymes- Mechanism of enzyme action- Allosteric regulatory enzymes.

UNIT IVMETAL IONS IN BIOLOGICAL SYSTEMS 6

Metal ions in proteins -Role on Zinc in carboxy peptidase- Iron and oxygen transport in Haemoglobin- Metal ion act as co-enzymes & Co factors in a biological reaction & Respiratory chain

UNIT V MEMBRANE CHEMISTRY 6

Structure- Active & Passive transport- ATP driven pumps – Ligand gated channels – Voltage gated channels.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biochemical reactions in living organism
CO2	to apply the concept of structural relationship between chemical and biochemical reactions
CO3	to create the drug formulation and its structural analogs in living systems comprehend genetics and the immune system
CO4	to know the role of metal ions in biological components and their importance in living systems
CO5	to get a basic knowledge of membrane transport and their permeability

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H		H					
	CO2	H							H		H	H	H
	CO3	H		H	H	H	H	H				M	
	CO4	H						M					
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Dugas. H, Bio-Organic Chemistry - A chemical approach to enzyme action, Springer Verlag, 2002, revised edition.

REFERENECE BOOKS

1. Faber. K, Biotransformations in Organic Chemistry- A text book, 4th Edition, Springer
2. Zubay .G. Bio chemistry, Max well Macmillan Publications, 2003 edition.
3. Weblink: nptel

U18PCBT406	IMMUNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – basics of immune system				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers

UNIT I **9**

THE IMMUNE SYSTEM

Introduction - antigens &their classification, complement and their biological functions, types of immune responses, Primary and secondary lymphoid organs-thymus, bone marrow and spleen

UNIT II **9**

HUMORAL IMMUNITY

B-lymphocytes and their maturation, activation &differentiation, structure and function of immunoglobulin, immunoglobulin classes, antibody mediated immune response and major histocompatibility complex.

UNIT III **9**

CELLULLAR IMMUNOLOGY

T -Lymphocytes their classification, maturation, activation & differentiation, antigen presenting, cells (APC), macrophages, langerhans cells, their origin and function, mechanisms of phagocytosis,Cell mediated immune response

UNIT IV **9**

ANTIGEN - ANTIBODY INTERACTION

Principle and application: Precipitation- Immuno diffusion &widal test, Agglutination reactions, Radio ImmunoAssay, ELISA, Immuno fluorescence technique, Immunoelecctrophoresis

UNITV **9**

TRANSPLANTATION AND AUTO IMMUNITY

Graft rejection, mechanisms of graft rejection and its prevention –hypersensitivity- Auto antibodies in humans,diseases- treatment of auto immune disorders

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of immune system												
CO2	to apply the techniques for antigen and antibody reaction												
CO3	to give the mechanism of immune response against antigens												
CO4	to know the natural barrier against pathogens												
CO5	to get a basic knowledge of the applications of immunology in transplantation												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H		H			
	CO2	H		H				H		H			
	CO3	H		H				H		H			
	CO4	H		H	M			H		H			
	CO5			H		H	H	H	H				H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Janis Kuby,2007, “Immunology” W.H. Freeman & Co. 6th ed.
2. Roitt I, 2001, "Essential Immunology". Blackwell Scientific Publications, Oxford,.

U18PCBT407	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Molecular biology, Cell biology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers

UNIT I CLONING 6

Introduction to Genetic engineering- Restriction enzymes, Restriction sites, Linkers and adapters. Markers for screening. Vectors- Characteristics- plasmid: EcoIi -.pBR 322, Cosmid-Shuttle vectors, Pblue script vectors ,Expression vectors, BAC, YAC, MAC. Characterizationof recombinant clones by Southern, Northern, Western Blotting

UNIT II CONSTRUCTION OF LIBRARIES AND NUCLEIC ACID LABELLING 6 Polymease Chain Reaction – types and applications. Semi quantitative and Real time PCR . Construction of genomic and cDNA libraries, Nucleic acid sequencing methods-Maxam Gilbert, Sanger dideoxy sequencing, Nick translation, RNA labeling and Fluorescent labeling. Genome mapping.

UNIT III APPLICATION OF rDNA TECHNOLOGY IN PLANTS 6

Method of gene transfer to plants- agrobacterium mediated / chemical mediated, Biolistics. Transgenic plants- Ri and Ti plasmids, Screening of recombinants-Direct and indirect methods, Single cell proteins using fungi.

UNIT IV APPLICATION OF rDNA TECHNOLOGY IN ANIMALS 6

Animal cloning, Ethical aspects of animal cloning,-Transgenic animals- sheep, goat, cattle, fish etc-Methods of gene transfer to animals-embryo transfer.

UNITV APPLICATIONS OF rDNA TECHNOLOGY IN INDUSTRY 6

Health care: Vaccines- DNA Vaccine, Recombinant vaccine. Hormones- insulin, Growth Hormone. Antibiotics - Streptomycin, Pencillin. Industrial enzymes – Amylase, protease

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of genetic engineering
CO2	to apply the concept of recombinant DNA IN plant, animal and microbial systems and growth in real life situations
CO3	to get the knowledge of molecular scissors and its role in creating transgenic products
CO4	Toknow the techniques related to screen the recombinant products
CO5	to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	H	L	H
	CO2	H	M	M	H	H	M	M	H		L		

	CO3	H	M		H					H	M	L	H
	CO4	H	M			H	H	M	M		M	M	M
	CO5	H	M	M		H		M		M		L	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Brown TA, 2000, "Gene cloning-and introduction" VNR (U.K) Co Ltd.

REFERENCE BOOKS

1. Setlow JK,2004, "Genetic engineering: principles and methods" Springer.
2. Fridal R,2006, "Genetic engineering" Lerner publications.
3. LeVine H,2006, "Genetic engineering-A reference handbook" ABC-CLIO.
4. Levine AD,2009, "Cloning" The Rosen publishing group, 1st.
5. Weblink: nptel

U18MCTH402 Constitution of India – Basic features and fundamental principles 2 0 0 0

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ownancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

Meaning of the constitution law and constitutionalism
Historical perspective of the Constitution of India

Salient features and characteristics of the Constitution of India

Scheme of the fundamental rights

The scheme of the Fundamental Duties and its legal status

The Directive Principles of State Policy – Its importance and implementation

Federal structure and distribution of legislative and financial powers between the Union and the States

Parliamentary Form of Government in India – The constitution powers and status of the President of India

Amendment of the Constitutional Powers and Procedure

The historical perspectives of the constitutional amendments in India

Emergency Provisions : National Emergency, President Rule, Financial Emergency

Local Self Government – Constitutional Scheme in India

Scheme of the Fundamental Right to Equality

Scheme of the Fundamental Right to certain Freedom under Article 19

Scope of the Right to Life and Personal Liberty under Article 21

U18PCBT4L1	**MICROBIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite- Microbiology, Molecular biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of microbes and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Laboratory rules and regulations
2. Isolation of Bacteria Soil
3. Motility of Bacteria
4. Staining techniques
5. Streak Plate techniques
6. Antibiotic sensitivity test
7. Isolation of Fungi
8. Water analysis by MPN
9. Milk Analysis
10. Biochemical Analysis

COURSE OUTCOMES (COs)	
CO1	to understand the source of microbes and their role in biotechnology
CO2	to get the knowledge of microbial diversity classification and morphology
CO3	to know the visualization of microbes by different microscopes
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens

CO5	to get a basic knowledge of the microbial nutrition and growth												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M		L					H		H	
	CO2	H						H					M
	CO3	H	H			H						H	
	CO4									L	H		
	CO5			M			L						L
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT4L2	**BIOCHEMISTRY LAB II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Biochemistry, Bioorganic chemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biochemical reactions, mechanisms and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Preparation of casein from milk.
2. Separation of starch from potato.
3. Extraction of chlorophyll in plant tissue.
4. Extraction of lactose from milk.
5. Estimation of glucose from grapes.
6. Extraction of fructose from honey
7. Extraction of lycopene from tomato.
8. Acetylation of D-glucose.
9. Preparation of methyl salicylate from aspirin.
10. Preparation of aspirin from salicylic acid.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of biochemical reactions in living organism												
CO2	to apply the concept of structural relationship between chemical and biochemical reactions												
CO3	to create the drug formulation and its structural analogs in living systemscomprehend genetics and the immune system												
CO4	to know the role of metal ions in biological components and their importance in living systems												
CO5	to get a basic knowledge of membrane transport and their permeability												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	H		H	H				H

	CO2		H	H			M					M	
	CO3	H		M	M	H					M		
	CO4		L	L				L	L	L			L
	CO5			H	H		M			H		M	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB407Literature, Cinema and Media (workshop, reading multiple news sources,analyze ads**)**
0 0 2 0

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description.
Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not justthe literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408 Literature & Media Group Reading (saamuhikvaachan) of classics 0 0 2 0
This will make group to read one or two books during a semester.
Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

U18BSMA501	STATISTICS FOR BIOSCIENCE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engg Mathematics-I &II				
	Course Designed by – Dept. of Mathematics				

OBJECTIVES

To provide a basic knowledge of probability and statistics

UNIT I - INTRODUCTION TO BIO-STATISTICS (numerical problems only) 9

Introduction to Biostatistics - Applications of Biostatistics. Handling univariate and bivariate data – Measures of central tendency – Measures of dispersion –Skewness& Kurtosis – Correlation and Regression.

UNIT II - PROBABILITY & THEORETICAL DISTRIBUTIONS 9 Probability concepts – conditional probability – Bayes' theorem – one dimensional random variables – expectation, variance, moments. Theoretical distributions: Binomial, Poisson, Normal (Problems only).

UNIT III - TESTING OF HYPOTHESIS 9 Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportions, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, independence of attributes.

UNIT IV - ANALYSIS OF VARIANCE 9

Small sample tests based on t and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances, ANOVA – one way classification, Two-way classification.

UNIT V- STATISTICAL QUALITY CONTROL AND RELIABILITY 9

Process control – control charts for variables - $\bar{X}$ and R, $\bar{X}$ and s charts. Control charts for attributes: p chart, np chart, c chart, Stability and Capability.

Reliability concepts, Failure rate analysis-calculation of MTFR and MTPR.

COURSE OUTCOMES (COs)	
CO1	Understand the computation of basic measures in Statistics
CO2	Understand the importance and the application of Probability in Engineering.
CO3	Various tools for testing the parameters based on samples.
CO4	How Design of Experiments are to be analysed.
CO5	Concepts of Process Control and various Charts to control the quality of products.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M		L			L	M	
	CO2	H	H	H	L		L		M				
	CO3	H	M								M		

	CO4	H	M	M					M	L			
	CO5	H		H	M			M		M	L		
3	Category	BS											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

(a) S.C.Gupta&V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003. [Units I to III].

(b) S.C. Gupta and V.K. Kapoor, "Applied Statistics". Sultan Chand and Sons, New Delhi 2004 [Units IV & V].

(c) Douglas C. Montgomory. "Design and Analysis of Experiments, Student Solutions Manual", 8thEdn: Wiley India Pvt Ltd., New Delhi-2. 2012.

REFERENCE BOOKS

1. Veerarajan T. "Probability Statistics and Random Process" Tata McGraw Hill, New Delhi 2003.
2. W.W. Daniel, "Biostatistics-A foundation for Analysis of Health Sciences", John Wiley and Sons, New Delhi 2000.
3. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability For Engineers", 6th Edition.Wiley India Pvt Ltd., New Delhi-2. 2010.
4. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

U18HSBA502	**ORGANIZATIONAL BEHAVIOR**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite :				
	Course Designed by: Dept of Management Studies				

OBJECTIVES

1. Knowledge on theories of Personality
2. Clear sight on the Decision Making in Groups
3. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour

UNIT **9**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

COURSE OUTCOMES (COs)													
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour												
CO2	Knowledge of the Interpersonal perception												
CO3	Awareness of the Merits and Demerits of Group decision making.												
CO4	Understanding of the Sources of power												
CO5	Familiarity with the knowledge of types of Conflicts												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		
	CO2				H	H		M		M		L	
	CO3		M				H					L	M
	CO4	H			H						L		
	CO5		M				M	M	H				M
3	Category	HS											
4	Approval	Academic Council, Aug 2018											

REFERENCE BOOKS

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

U18PCBT501	**PRINCIPLES OF BIOPROCESS TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics –II, Principles of chemical Engineering.				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of Process techniques in industries

UNIT I INTRODUCTION TO BIOPROCESSES 9

Historical development of bioprocess technology, Biotechnology & Bioprocess engineering- outline of Unit Operations involved in Upstream and downstream processing, generalized process flow sheets.

UNIT II GROWTH MEDIA AND STERILIZATION 9

Medium requirements for fermentation, Carbon, Nitrogen, Minerals, Vitamins, and other complex nutrients, medium formulation – Media- Types of media – Sterilization: Batch and continuous heat sterilization of liquid media- filter sterilization of liquid media- Sterilization kinetics- Del factor.

UNIT III STOICHIOMETRY OF MICROBIAL GROWTH 9

Stoichiometry of Cell growth and product formation- elemental balances- degrees of reduction of substrate and biomass-available electron balances-yield coefficients of biomass and product formation

UNIT IV INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO_2- cell mass, cell number.

UNITV INDUSTRIAL BIOPROCESSES

Bioprocesses: Production of lactic acid, sugar, baker's yeast, High fructose corn syrup, bioethanol, biodiesel, biogas, Pharma product: penicillin, aspirin

COURSE OUTCOMES (COs)													
CO1	to understand the development of bioprocess techniques.												
CO2	to know about the instrumentation and control for bioprocess operations												
CO3	to get idea about media formulations												
CO4	to know about stoichiometry of bioprocess.												
CO5	to know about various bioreactors												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Shuler and Kargi, 2005 "Bioprocess Engineering",Prentice Hall

REFERENCE BOOKS

1. Bailey and Ollis, 2000, "Biochemical Engineering Fundamentals", McGraw Hill 3rd ed.
2. Stanbury PF,1984, "Principles of fermentation technology" SS Hall, 2nd.
3. Dr.Mansi El Mansi.2003 "Fermentation Microbiology & Biotechnology".IVEd.
4. P.T. Kalaichelvan and I. Arul Pandi. 2007 "Bioprocess technology" MJP Pub, 1st ed.

U18PCBT502	CHEMICAL REACTION ENGINEERING	L	T	P	C
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I &II, Unit operations				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of Reaction engineering					

UNITI KINETICS OF HOMOGENEOUS REACTIONS 9

Scope of chemical kinetics, various types of reaction Basic terms and Definition: Rate, Rate law, Order, Molecularity , Elementary and Non Elementary reaction. Testing kinetic model for Non Elementary reaction theories of chemical reaction- temperature dependency theories.

UNIT II INTERPRETATION OF BATCH REACTOR DATA 9

Arrhenius law, Calculation of Activation energy, Rate, Rate constant-Constant Volume Batch reactor – Integral and Differential method of analysis- Analysis of total pressure data in constant volume system- Rate Equation: Irreversible Unimolecular I and II order and irreversible bimolecular II order (Equimolar and Non equimolar) .

UNIT III DESIGN OF SINGLE IDEAL REACTORS 9

Half-life period – Variable volume batch reactor .Constant Density & Changing Density Batch and Flow system – Design of ideal batch reactor – Space time and Space velocity – Design of MFR & PFR calculation of X_A, $\tau_{MFR,}$,τ_{PFR}

UNIT IV MULTIPLE REACTOR SYSTEM FOR SINGLE REACTIONS 9

Significance of choice of reactor system- Comparison of MFR with PFR I order & II order – Reactor in series: CSTR in series –Unequal size CSTR in series, Equal size CSTR in series – PFR in series. Non ideal reactors.

UNITV BIOREACTOR 9

Biochemical reaction: Bioprocess &Bio reaction- Cell multiplication kinetics- types of bioreactors- Some industrial application of bioprocess: Aerobic and anaerobic bioprocess.

TEXT BOOK:

1. K.A.Gavhane, 2009, "Chemical Reaction Engineering I" NiraliPrakasham Publications, 19th.

REFERENCE BOOKS:

1. K.A.Gavhane, 2009, "Chemical Reaction Engineering II" 21st ed.
2. Octave Levenspiel, 2006, "Chemical Reaction Engineering" Wiley-India, 3rd Edition
3. Weblink: nptel

COURSE OUTCOMES (COs)	
CO1	to understand basic concepts in homogenous reactions

CO2	to know about various order reaction
CO3	to know about the plug flow and mixed flow reactor
CO4	to know about multiple reactors
CO5	to know about design of bioreactors

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCTH503 UNIVERSAL HUMAN VALUES **2 0 0 0**

The objective of the course is four fold:

Sensitization of student towards self, family (relationship), society and nature.

Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.

Strengthening of self reflection.

Development of commitment and courage to act.

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

	MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB	**L**	**T**	**P**	**C**
U18PCBT5L1	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Molecular biology,rDNATechnology,Microbiology.				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Extraction of plant genomic DNA by Dellaporta method.
2. Extraction of animal DNA.
3. Extraction of bacterial genomic DNA.
4. Isolation of plasmid DNA by alkaline lysis method.
5. Extraction of fungal DNA.
6. Quantitative estimation of DNA.
7. Effect of UV radiation on bacterial survival.
8. Agarose gel electrophoresis.
9. Restriction digestion and ligation of DNA.
10. DNA amplification by PCR.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of genetic engineering
CO2	to apply the concept of recombinant DNA IN plant, animal and microbial systems and growth in real life situations
CO3	to get the knowledge of molecular scissors and its role in creating transgenic products
CO4	to know the techniques related to screen the recombinant products.
CO5	to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	M	H	H	L	L	M
	CO2	H	M				L		H	M	L		
	CO3	H	M	H	H	H	H	M	H	H	L		
	CO4	H			H	H	H	M	M	M		L	M
	CO5	H	M	M	H					L	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT5L2	**CHEMICAL ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – principles of chemical engg,chemical reaction engg,mechanicaloperations, Mass&Heat Transfer				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES:To provide a knowledge about heat, mass transfer and reaction kinetics					

LIST OF EXPERIMENTS

1. Batch Reactor I& II
2. Multiple reactor system
3. Drying studies in Tray dryer
4. Simple Leaching
5. Adsorption
6. Heat transfer through Natural convection
7. Heat transfer through Forced convection
8. Heat transfer through composite wall
9. Size reduction and Sieve Shaker Analysis

10. Magnetic Separator
11. Analysis of chloride content in Cement
12. Analysis of chlorine content in Bleaching Powder

COURSE OUTCOMES (COs)													
CO1	to get knowledge about reactor kinetics												
CO2	to know about drying equipment												
CO3	to get idea about heat transfer												
CO4	to know about mass transfer operations												
CO5	to understand about mechanical operations												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H	L		H		L
	CO2			L		M				L		L	
	CO3	H	L		M		H	H			H		L
	CO4								M	L			
	CO5	H		M							H		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

Self Development

U18MCAB509 SPIRITUAL, MINDFULNESS AND MEDITATION 0 0 2 0

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions:
multiple 10-day sessions may be organized over a semester.

U18MCAB510 RELIGION AND INTER-FAITH 0 0 2 0

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under 'book reading'.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

U18PCBT601	**ANIMAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Molecular biology, Genetic engineering, Microbiology, Immunology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological mechanisms and their applications from the perspective of engineers

UNIT I INTRODUCTION 9

History of animal cell and organ culture-requirements for animal cell and organ culture-characteristics of animal growth in culture-substrates for cell culture and its treatment-culture media-natural and synthetic media- sterilization of glassware, equipment and culture media.

UNIT II ANIMAL CELL CULTURE 9

Equipment required for animal cell culture-isolation of animal material- disaggregation of tissue by physical and enzymatic methods- establishment of cell culture-evolution of cell lines-primary and secondary cell culture-types of cell lines-factors affecting subculture in vitro.

UNIT III SUSPENSION CULTURE 9

Cultivation of animal cells in bioreactor-Suspension cultures-methods of scaling up of cell culture-roller bottle-spinner culture-immobilized cell culture-insect cell culture-somatic and organ cell culture- organ culture on plasma clots, agar and liquid medium-whole embryo culture-production of commercially valuable products obtained from animal and insect cell culture-hybridoma technology.

UNIT IV MANIPULATION OF REPRODUCTION 9

Manipulation of reproduction in animals-artificial insemination-semen collection and storage-ovulation control-embryo transfer-multiple ovulation and embryo transfer-embryo splitting and sexing-in vitro fertilization-nuclear transplantation-problems related to test tube babies-infertility in humans.

UNIT V TRANGENICS 9

Techniques of gene transfer in animals-transgenic animals- transgenic sheep and fish-knockout mice-animal bioreactor and molecular farming-diagnosis, elimination and breeding strategies of genetic diseases-PCR based markers-xenotransplantation-mapping of human genome-bioethics in animal genetic engineering.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of animal cells and culture
CO2	to apply the techniques for animal cell culture and its types
CO3	to comprehend genetics system
CO4	to know the large scale of cell cultures in a bioreactor
CO5	To know about the immune system

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H			L	L	
	CO2	H	M	M	H	H		M		M	L		M
	CO3	H			H	H	M	H	H			L	M
	CO4	H	M		H			M			L		
	CO5	H	M	M	H	H		M	M	M	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. R.C. Dubey, 2005, "A textbook of Biotechnology", 3rd ed.

REFERENCE BOOK

1. Stewart Sell, 2004, "Stem Cells Hand Book" Humana Press.
2. John R.W. Masters, 2000, "Animal Cell culture a practical approach" Oxford University Press, 3rd ed.
3. YoshitoIkada, 2006, "Tissue engineering fundamentals and applications" Academic Press, 3rd ed.
4. John P. Fisher et al, 2007, "Tissue engineering" CRC Press.
5. Nigel Jenkins,2007, "Animal Cell Biotechnology" Hamana press, 2nd ed.
6. P. Ramadass. 2008 "Animal Biotechnology", MJP Pub.
7. Weblink: nptel

U18PCBT602	**ENZYME ENGINEERING AND TECHNOLOGY**	**L**	**T**	**P**	**C**

	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Biochemistry, Unit operation, Chemical reaction engg.				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a knowledge about enzymes and its kinetics

UNITI INTRODUCTION **9**

Introduction- chemical nature of enzyme, coenzyme, cofactor, holoenzyme - Naming and classification- advantages and disadvantages of enzyme catalysis- historical highlights- application of enzymes in Pharma, food and other industries.

UNITIIENZYME KINETICS **9**

Mechanism of enzymatic reaction – Michaelis -Menten Kinetics, Briggs-Haldane approach – Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot - Enzyme inhibition – kinetics of competitive and non-competitive inhibition-un competitive inhibition.

UNIT III CELL GROWTH

Typical growth characteristics of microbial cells: Phase of growth curve, factors affecting growth- Monod model.

UNIT IV IMMOBILIZATION OF ENZYME AND CELL **9**

Immobilization Of Enzymes: Carrier binding: physical adsorption, ionic binding, covalent binding – cross linking method- Entrapping of enzyme- Uses of immobilized enzymes. Immobilization of cell.

UNIT V PRODUCTION AND PURIFICATION

Fermentation-Types: submerged fermentation, solid state fermentation, advantages and disadvantages- scale up – scale down. Purification: precipitation, drying, crystallization.

COURSE OUTCOMES (COs)	
CO1	to understand the applications of enzymes in various fields
CO2	to know about enzyme inhibition
CO3	to know about kinetics of enzyme
CO4	to know about immobilization and its applications
CO5	to get knowledge about transport in cell

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	L	M	L	L	M
	CO2	H	M	M	H	H						L	M
	CO3	H	M		H	H		M	H	H	L		
	CO4	H	L		H			M			L	L	M
	CO5	H	M	M	H	H					L		M
3	Category	PC											

4	Approval	Academic Council, Aug 2018

TEXT BOOK

1. Manjula, 2006, "Bio and Enzyme Engineering", III Ed.

REFERENCE BOOKS

1. J.B.Bailey and D.F. Ollis, 2005, "Biochemical Engineering Fundamentals" McGraw Hill, New York.
2. Dr.Mansi El Mans, 2006 "Fermentation microbiology and biotechnology" IV Ed,
3. Weblink: nptel

U18HSBT601	**BIOENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about Entrepreneurship					

UNIT I ENTREPRENEURSHIP FUNDAMENALS 9

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

UNITII DECISION MAKING AND TIME MANAGEMENT 9

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

UNIT III FINANCE AND ECONOMIC FEASIBILITY 9

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

UNIT IV COMPANY LAWS AND REGULATIONS 9

Forming company – Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9

Various business opportunities in Biotechnology – Development of Biotech companies in India – Case studies on Biotech companies and its growth

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of Entrepreneurship
CO2	to know about time management
CO3	to explore the avenues for financing a business venture
CO4	to know about various company laws
CO5	to understand Entrepreneurship in biotechnology
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	H	M	M	M				L	
	CO2	H	M	M	H	H		M		M	L	L	M
	CO3	H	M	M	H	H	L		H		L		M
	CO4	H	M			H		M			L	L	M
	CO5	H	M	M	H	H		M		M	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Exploring Entrepreneurship: D. Allan Barefield and George F. Smith, Ettmae Westbrook, Tennesse State University, 2006

REFERENCE BOOK

1. Entrepreneurship fundamentals by ZobiasKollmann International journal of Technology management,2007

U18PCBT603	BIOPROCESS ENGINEERING	L	T	P	C
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Chemical reaction engg., Unit operation, Animal biotechnology, Plant biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES:

To provide a knowledge about various bioprocesses and the designing of reactor

UNIT I MASS TRANSFER IN BIOPROCESS SYSTEM 9

Role of diffusion in bioprocess- Film theory- Oxygen uptake in cell culture, factors affecting cellular Oxygen demand, Oxygen transfer from gas bubble to cell, Measuring DO concentration, measurement of K_La .

UNIT II DESIGN AND ANALYSIS OF BIOPROCESSES 9

Methods of on-line and off-line biomass estimation; microbial calorimetre; Flow injection analysis- -Biosensor.-PIDcontrol, computers in Bioprocess control. Homogeneous Reaction: Production kinetics in cell culture-Substrate Uptake rate-Effect of culture condition on cell kinetics-determination of cell kinetic parameters from batch data

UNIT III MIXED CULTURE IN BIOPROCESS 9

Introduction: competition, neutralism, mutalism, commensalism, predation, parasitism- mixed culture in nature- industrial utilization of mixed culture: waste water treatment, advanced waste water treatment process – conversion of waste water to useful product

UNIT IV MODERN BIOTECHNOLOGICAL PROCESSES 9

Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures.

UNITV MODELLING AND SIMULATION OF BIOPROCESSES 9

Study of Structured models for analysis of various bioprocesses; Computer based data acquisition, Monitoring and control- Lab view software, MATLAB-SIMULINK

COURSE OUTCOMES (COs)													
CO1	to know basic concepts in bioprocess engineering												
CO2	to know different types of plant and animal cell bioreactors												
CO3	to understand basic concepts in transport phenomena in bioprocessing												
CO4	to get knowledge about bioreactor design												
CO5	to know about modern biotechnological processes												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H		L	L	
	CO2	H	M	M	H	H		M		M	L	L	
	CO3	H	M		H	H		M				L	M
	CO4	H	M		H		L				M	L	M
	CO5	H	M	M	H	H		M	M		L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Shuler and Kargi, 2004, "Bioprocess Engineering Fundamentals", McGraw Hill 2nd Ed.

REFERENCES

1. Sameer A. Zodgkar,2008, "Bioprocess" ICFAI University Press, 1st.
2. P.T. Kalaichelvan and I. Arul Pandi. 2007 "Bioprocess technology". MJP Pub.
3. FunshangYabgJuming Tang, 2002, "Advances in Bioprocess Engineering" World scientific publishing company 2nd.
4. Syed Tanveer Ahmed Inamdar, 2007, "Biochemical Engg principles & concepts" Prentice Hall of India,2ndEdition.

U18MCTH604 Essence of Indian knowledge Tradition 2 0 0 0

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

U18PCBT6L1	**BIOPROCESS ENGINEERING LAB 1**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Bioprocess Engg., Unit Operation				

	Course Designed by – Dept. of Industrial Biotechnology
OBJECTIVES: To provide basic knowledge about bioprocessing	

LIST OF EXPERIMENTS

1. Culturing of different types of microorganism
2. Estimation of biomass production.
3. Enzyme kinetics.
4. Effect of temperature on enzyme activity.
5. Effect of pH on enzyme activity.
6. Effect of substrate concentration on growth of *E.coli.*
7. Immobilization of enzyme.
8. Estimation of k_La by sulphite oxidation method.
9. Thermal death kinetics of yeast.
10. Thermal death kinetics of bacteria.

COURSE OUTCOMES (COs)													
CO1	to get knowledge on biomass												
CO2	to know about enzyme kinetics												
CO3	to understand about immobilization of enzyme												
CO4	to get idea about mass transfer												
CO5	to know about death kinetics												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	M		M		H	L		M
	CO2	H	M	M	H	H			M			L	
	CO3	H	M	M	H			M			L	L	M
	CO4	H	M	H	H	H			H	M		L	M
	CO5	H	M	M		H	L	M			L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT6L2	**PLANT AND ANIMAL BIOTECHNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Plant biotechnology, Animal biotechnology, Genetic engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of plant and animal cell culture techniques					

LIST OF EXPERIMENTS

1. Sterilization techniques.
2. Plant tissue culture techniques.
3. Preparation of culture medium
4. Callus induction in *Daucuscarota.*
5. Nodal bud culture.
6. Micropropagation of rose.
7. Rooting and hardening of regenerated shoots.
8. Isolation and purification of protoplast from *Aloe vera*leaf mesophyll cells.
9. Determination of protoplast viability using Evan's blue staining.
10. Protoplast fusion using PEG.
11. Preparation of synthetic seeds.
12. Isolation of Rhizobium from ground nut nodules.
13. Preparation of Rhizobialbiofertilizer.
14. Aseptic techniques for animal cell culture.
15. Establishment of a primary culture.
16. Resuscitation of frozen cell lines.
17. Subculture of adherent cell lines.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of plant biotechnology
CO2	to know about sterilization techniques
CO3	to know about plant tissue culture
CO4	to know about animal cell culture
CO5	to get a basic knowledge of the applications using plant biotechnology

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M	H	H	L	M			
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H	M	H	L	M	L		M
	CO4	H	M		H	H		M			L	L	
	CO5	H	M	M	H	H	H	H		M	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT6L3	**IMMUNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Immunology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES
To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. SDS- Slab gel electrophoresis of immunoglobulins
2. Western blotting
3. Immunoelectrophoresis
4. Countercurrent Electrophoresis
5. Rocket Immunoelectrophoresis
6. Single radial immunodiffusion
7. Double immunodiffusion
8. Dot- ELISA
9. DEAE cellulose chromatography for IgG.
10. Affinity chromatography for antiserum purification.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of immune system												
CO2	to apply the techniques for antigen and antibody reaction												
CO3	to give the mechanism of immune response against antigens												
CO4	to know the natural barrier against pathogens												
CO5	to get a basic knowledge of the applications of immunology in transplantation												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	M		L
	CO2	H	M	M		H		H				L	
	CO3	H			H			H	M	H			M
	CO4	H	M					M				L	
	CO5	H	M	M	H	H	H	H	L		L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB611 SOCIAL AWARENESS (Artisans-relates to engg., visit to hospitals, orphanages, policestation, courts, trauma centers, consumer forums) **0 0 2 0**

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in *BanarasiSaari*, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of actions.

U18MCAB612 SOCIAL SERVICE (teach in neighborhood, adopt an underprivileged school, villagestay / visit (NSS), cleanliness drive, and skill transfer**)** **0 0 2 0**

U18PCBT701	DOWNSTREAM PROCESSING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Unit Operation, Bioprocess engineering				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about various separation techniques in bioprocesses

UNIT I ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY 9

Role and Importance of downstream processing in biotechnological processes- Problems and requirements of bioproduct purification-Economics of downstream processing in Biotechnology, cost - cutting strategies, characteristics of biological mixtures, Downstream processing steps for various classes of bioproducts (high volume, low value products and lowvolume, high value products), physico- chemical basis of bioseparation processes.

UNIT II PRIMARY SEPARATION AND RECOVERY PROCESSES 9

Cell distribution methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods.Basic problems to calculate time of filtration, medium and cake resistance – centrifugation problem.

UNIT III ENRICHMENT OPERATIONS 9

Membrane separations (micro and ultrafiltration theory, and configuration of membrane separation equipment) applications, precipitation methods - extractive separations, aqueous two phase extraction, supercritical extraction- *insitu* product removal, integrated bioprocessing.

UNIT IV PRODUCT RESOLUTION/FRACTIONATION 9

Adsorptive chromatographic separation processes, electrophoretic techniques.

UNIT V PRODUCT POLISHING 9

Gel Permeation Chromatography, dialysis, Crystallization: nucleation, crystal growth and crystallization equioment.

COURSE OUTCOMES (COs)	
CO1	to understand the unit operations involved in downstream
CO2	to know about various separation processes
CO3	to know about the product recovery and purification techniques
CO4	to understand the unit operations involved in downstream
CO5	to know about various separation processes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M				L	M
	CO2	H	M	M	H	H			H	M	L	L	

	CO3	H	M		H	H		H				L	M
	CO4	H	M		H			M	L		L	L	M
	CO5	H	M	M	H	H		H		M	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. SivaShankar , 2004, "BioSeparation" III Ed,

REFERENCE BOOKS

1. Wankat P.C, 2003, "Rare Controlled Separations", Elsevier,.
2. Better PA and Cussier E, 2002,"Bioseparations", Volley,
3. Weblink: nptel

U18PCBT702	RESEARCH METHODOLOGY AND INSTRUMENTATION	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about various instrumentation techniques and data documentation

UNIT I BASIC PRINCIPLES FOR BIOCHEMICAL ANALYSIS 9

Introduction – preparation of organ and tissue samples for analysis – cell disruption methods – physiological solutions: buffers and growth media for plants, animals and microbes –cell sorting, isolation and enumeration techniques – cryopreservation – elucidating metabolic pathways by tracer studies.

UNIT II SPECTROSCOPIC AND MICROSCOPY TECHNIQUES 9

Introduction – UV – visible spectroscopy – NMR spectroscopy – IR and Raman spectroscopy – atomic spectroscopy - Introduction to microscopy – Electron microscopy –ultramicrotome- phase contrast microscopy – Fluorescent and confocal microscopy.

UNIT III SEPARATION TECHNIQUES 9

Introduction to chromatography and electrophoresis – gel filtration – ion exchange – affinity – GC – HPLC - partition chromatography – electrophoresis of proteins and nucleic acids – immune precipitation techniques – ELISA.

UNIT IV ETHICAL ISSUES IN BIOTECHNOLOGY 9

Legal and socio economic impacts of biotech research – bio safety regulation – r-DNA guidelines- issues involved in experimenting with animals – Experimental protocol approvals – impact of GM organisms and GM foods – IPR and patents.

UNIT V DATA ANALYSIS AND DOCUMENTATION 9

Sampling concepts for statistical analysis – Mean, median, standard deviation, standard error – ANNOVA – Guidelines for thesis writing: literature collection methods – writing of abstract, introduction and review of literature – results, discussion and summary – guidelines to publish articles in journals.

COURSE OUTCOMES (COs)													
CO1	to understand the biochemical analysis												
CO2	to know about spectroscopic and microscopic techniques												
CO3	to know about the separation techniques												
CO4	to get ideas about ethical issues related to research												
CO5	to know about data documentation												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H	H	M	M	M
	CO2	H	M	M	H	H		H			L	L	
	CO3	H	M	H	H	H		M	H		M		M
	CO4	H	M	H	H	H	H	H		M		M	H
	CO5	H	M	M	H	H		M	H		L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Keith Wilson and John Walker,2004, Practical biochemistry, Principles and techniques – Cambridge publication
2. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.

REFERENCE BOOKS

1. P. Ramadass, 2009, Research and writing: Across the disciplines, MJP publishers.

U18PCBT703	**NANOBIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about nanoscience involved in biotechnology					

UNIT I INTRODUCTION 9

Introduction to nanobiotechnology –Synthesis & characterization of nanoscale molecules – Nanoarchitecture – Fabrication technologies – Self-assembly systems

UNIT II NANODEVICES 9

Inorganic nanoscale systems – Properties of fullerene carbon nano tubes – Quantum dots – Gold nanoparticles – Magnetic nanoparticles – Nanopores.

UNIT III NANOBIOMATERIALS 9

Interaction of nanomaterial and biomolecule: Classification of biomaterial – Bone cement – Biointeractive hydrogels – Nanobiomaterials: Collagen, Dextran, Hydroxyapetite – Role of nanoparticles in blood clotting – Nanomotors.

UNIT IV MICROBIAL NANOTECHNOLOGY 9

Nanotechnology and microorganisms: PHA – Magnetosomes – Cyanophycin inclusions – Alginates – Bacteriophages – Bacterial spores – S-layer proteins – Bacteriorhodopsin.

UNIT V NANOMEDICINE 9

Nanotechnology in drug delivery – Nanoscale devices for drug delivery: Micelles, Nanocapsules, Lipososmes, Dendrimers –Nanobiosensors – Nanotechnology for cancer diagnosis & treatment.

COURSE OUTCOMES (COs)													
CO1	to understand the various nano devices												
CO2	to know about nano molecules												
CO3	to learn the applications of nanotechnology in proteins, lipids and nucleic acids												
CO4	to know about the applications of nanotechnology in microbiology												
CO5	to know about nano technology involved in drug delivery system												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		H				L	M
	CO2	H	M	M	H	H		M			L		L
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H					L	L	M
	CO5	H	M	M	H	H		M				L	L
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.K. Jain , 2006, "Nanotechnology in molecular diagnostics – current techniques & applications", Horizon Bioscience publishers

REFERENCE BOOKS

1. Microbial bionanotechnology:Biological Self-Assembly Systems and Biopolymer-Based Nanostructuresed: Bernd Rehm, Taylor and Francis, 2006
2. Applications of nanoparticles in biology & medicine O.V. Salata, Journal of nanobiotechnology (2004),
3. Weblink: nptel

U18PCBT7L1	**BIOPROCESS ENGINEERING LAB II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Microbiology, Bioprocess Engineering, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide knowledge about production of bioproducts					

LIST OF EXPERIMENTS

1. Plate assay
2. Media optimization by Plackett-Burmann method
3. Solid state fermentation.
4. Production of wine
5. Estimation of alcohol concentration in wine.
6. Estimation of acid concentration in wine.
7. Production of soap and analyze its properties.
8. Production of biodiesel and analyze its properties.
9. Production of citric acid
10. Production of biofertilizer.

COURSE OUTCOMES (COs)													
CO1	to know about media formulation												
CO2	to know about media sterilization												
CO3	to understand about Solid State Fermentation												
CO4	to get basic idea about production of natural wine and biofuel												
CO5	to get basic idea about production of soap												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT7L2	**DOWNSTREAM PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Downstream Processing, Microbiology, Unit Operation				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide knowledge about purification of bioproducts					

LIST OF EXPERIMENTS

1. Isoelectric precipitation
2. Settling characteristics
3. Flocculation (Jar Test)
4. Solids Recovery by Centrifugation
5. Paper chromatography
6. Thin Layer Chromatography
7. Ion –Exchange Chromatography
8. Affinity Chromatography
9. Gel Filtration
10. Desalting of Protein Sample by Gelfiltration
11. Sonication
12. Crystallization
13. Aqueous Two Phase Extraction Of Proteins
14. Enzyme Purification by Salt precipitation Method.

COURSE OUTCOMES (COs)													
CO1	to know about precipitation technique												
CO2	to understand about flocculation and settling												
CO3	to get basic idea about chromatographic techniques												
CO4	to get basic idea cell disruption												
CO5	to know about extraction												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M					H			L	M
	CO2	H	M	M	H	H		M		M	L		
	CO3	H	M		H	H		M			L		M
	CO4	H	M						M	L	L	L	
	CO5	H	M	M	H	H		M			L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB713 Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

0 0 2 0

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing different

aspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.

To help the students to understand the importance of non-verbal aspects of effective communication.

To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.

To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

Motivational lectures

Group Discussions/activities

Case Study

Games/Stimulation Exercises

Role-Playing
Mindfulness training.

U18MCAB714NATURE CLUB (bird watching, recognizing plants at institute/at home, recognizinglocal animals, appreciating biodiversity) **0 0 2 0**

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.
Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18MCAB815INNOVATION **0 0 2 0**

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.
Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.
Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance.

PROFESSIONAL ELECTIVE I

U18PEBT011	**BASIC HUMAN NUTRITION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers

UNIT I NUTRITIONAL SCIENCE 9

Nutritional science – historical perspective, Importance and functions of food, Food constituents : carbohydrates, proteins, lipids

UNIT II IMPORTANCE AND FUNCTION OF FOOD 9

Importance and functions of food minerals and vitamins-their role and functions, dietary requirements of food for infants, pre-school children, adults, Pregnant and nursing mothers. Under nutrition and malnutrition.

UNIT III NUTRITION AND GENETICS 9

Nutrition and aging, Nutrition and human genetics– genetic determinants of nutrient needs, genetic abnormalities, racial differences in nutrient needs.

UNIT IV NUTRITION AND IMMUNE SYSTEM 9

Nutritional processing, the frequency of genetic abnormalities, gene stability, genetic change and carcinogenesis, genetic basis of obesity, nutrition and immune system, nutritional disorders, Food in relation to health and diseases.

UNIT V FOOD POLICIES 9

Inborn errors of metabolism.Losses of vitamins and minerals due to food processing.Food pattern. Food policies – applied nutrition programme.

COURSE OUTCOMES (COs)	
CO1	To know about importance of food
CO2	To give knowledge about functions of food
CO3	To understand about human nutrition and genetics
CO4	To give knowledge about food and immune system
CO5	To understand about various policies about food

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	M		L		M
	CO2	H		M	H	H		M			L	L	M
	CO3		M		H	H	H	M		M	L	L	M
	CO4	H	M		H	H		M	L		L	L	
	CO5	H	M	M	H	H		M		L	L		M

3	Category	PC
4	Approval	Academic Council, Aug 2018

TEXT BOOK

1. Text Book of Human Nutrition by Bamji M.S., Oxford IBH.

REFERENCE BOOKS

1. Human Nutrition and Dietetics by Garrow, J.S., James, W.P. T. and Ralph, A. 2000. Churchill Livingstone, Edinburgh.
2. Human Nutrition by Barasai.
3. Food Science and Human Nutrition by Swaminathan Vol.1-2.

U18PEBT012	**MEDICAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Immunology, physiology, animal biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological systems and their applications from the perspective of engineers

UNIT I HUMAN GENETICS 9

Genes and Chromosome- structure, function and inheritance- Repetitive DNA in human genome-Alu, LINE and SINE repeats- Congenital abnormalities, Clinical aspects of autosomal and sex chromosomal disorders. Gene therapy and its types

UNIT II HUMAN PHYSIOLOGY 9

Structure, types and functions of tissues and muscles-Biological functions and abnormalities of digestive system, circulatory system, excretory system and central nervous system

UNIT III HORMONES 9

Hormones- structure, classification, biosynthesis and circulation in blood- Synthesis transport and biological functions of pituitary hormones, thyroid hormones and pancreatic hormones

UNIT IV CLINICAL BIOCHEMISTRY 9

Blood sugar level in diabetes mellitus- Blood pressure and cholesterol level in heart attack-Clinical significance of diagnostic enzymology- Evaluation of renal, pancreatic, liver and intestinal function

UNIT V GERM LINE ENGINEERING 9

Characteristics and diagnostic applications ofstem cell culture, organ culture, embryo culture – Artificial blood- Genetic counseling-Artificial insemination, IVF and embryo transfer in humans- Egg and sperm Preservation banks

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of genetics and their relationship to hereditary disorders
CO2	to apply the concept of plant, animal and microbial systems in discovery of medicine
CO3	to comprehend genetics and the immune system
CO4	to know the cause, symptoms, diagnosis and treatment of common diseases
CO5	to know the cause, symptoms, diagnosis and treatment of common diseases
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lehninger Nelson &Cox., 2009 "Principles of Biochemistry",5th edition
2. Chatterjee and Raneshinde2009 "Clinical Biochemistry"7th edition.

REFERENCE BOOKS

1. Guyton,2010 "Medical physiology", 12th edition
2. Devlin, 2005 "Biochemistry with clinical correlation", 10th edition
3. Weblink: nptel

	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
U18PEBT013	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Microbiology, Environmental Studies				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about environmental issues related to bioprocess and its remedial measures

UNIT I MICROBIOLOGY OF AIR AND WATER 9

Microbial Contamination of air-Enumeration of bacteria in air-Air Sampling devices-Air Sanitation and purification methods-Determination of Water quality-Bacteriological examination of water-indicator organisms-Water borne pathogens

UNIT II MICROBIOLOGY OF SOIL 9

Microbial flora of soil, Growth, Ecological adaptation, Interaction among soil microorganisms-Microorganisms involved in nitrogen fixation, Positive and negative role of microbes.

UNIT III DETOXIFICATION 9

Detoxification of Hazardous chemicals-Biocatalyst for pesticide Detoxification- Bioremediation: Bioremediation of Persistent chemicals-Improving catabolic processes, Biosorption of Heavymetals-Bioremediation of oil spills, Bio deterioration of paper, Textile, sugar distilleries, diary industries.

UNIT IV BIOWASTE UTILIZATION 9

Biotechnology for biowaste conversion in to bioresources-Single cell protein, Mushroom, Algal growth for fisheries, and Aqua culture- Industrial waste recycling -Waste fueled furnaces.

UNIT V BIOSAFETY AND IPR 9

Intellectual Property, Rights in bioremediation, Biosafety-Microbiology. Medical Laboratory-Medical waste- Bioharzardous waste-Sharps-Pathological waste-Rules and Regulations-Biosafety protocol

COURSE OUTCOMES (COs)

CO1	to understand the microbiological concepts in air
CO2	to know about various bioremediation techniques
CO3	to know about biosafety
CO4	to know about microbiology of water
CO5	to get idea about microbiology of soil

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Bruce. E.Rittaman and Perry. L. Mc Carty, 2004, "Environmental Biotechnology-Principles and applications" McGraw Hill.
2. N. Ahmed, F.M. Quershi and D. Y.Khan, 2001, "Industrial Environmental Biotechnology" Horizon press.

REFERENCE BOOKS

1. W.D. Grand, P.E. Long Blakies, "Environmental Microbiology", Glasgow London.
2. T. Meenambal, 2009, "Environmental Science and Engineering".

Weblink: nptel

PROFESSIONAL ELECTIVE II

U18PEBT021	**DAIRY TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess, Food process engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To explore the different techniques involved in diary science

UNIT I INTRODUCTION 9

Market milk – market milk industry in India – Collection, Transportation of milk- milk reception – Clarification- Chilling – Homogenization – Sterilization- Pasteurization – UHT processing of fluid milk – aseptic packaging – Special milk – Clean Milk Production – Grading of Milk.

UNIT II DAIRY PRODUCTS 9

Fat rich Dairy products – Cream, preparation, types, defects – Butter preparation, types, defects – Butter Spreads- Preparation of Ghee , defects in ghee- AGMARG standards- Frozen dairy products – Manufacture of Ice Cream: Ingredients and their role, types and defects, Judging and grading of Cream, Butter and Ice Cream. Concentrated and dried milk Products- Condensed milk – Evaporated milk – BIS standards –defects- Manufacture of milk powder- whole milk, skim milk powder- spray drying – whey powder- whey protein concentrates- biodiesel from whey.

UNIT III CHEESE AND FERMENTED PRODUCTS 9

Cheese and fermented products- Classification- preparation of cheddar, cottage, mozzarella and processed cheese- cheese spreads- ripening – accelerated ripening- action of rennet – microbial rennet – milk coagulating enzymes – defects in cheese, causes and control measures- fermented milk products – Manufacture of Dahi- yogurt- shrikhand- therapeutic effects of fermented milk products- functional foods- probiotics - prebiotic -symbiotic.

UNIT IV INDIGENOUS MILK PRODUCTS 9

Indigenous milk products and by products – Channa – Chana based products – preparation of Khoa and Khoa based products – peda- Gulabjamun – Rasagolla – preparation of paneer – kulfi – utilization of skim milk – butter milk – whey.

UNIT V QUALITY CONTROL AND QUALITY ASSURANCE 9

Introduction- Cleaning and Sanitation – Sterilization agent- Can Washing- Manual & Mechanical washing – Washing treatments – Cleaning in Place Programmes (CIP) – Packaging of milk & Milk Products – Function- Packaging Material – Filling system – Aseptic Packaging

COURSE OUTCOMES (COs)	
CO1	To study the process involved in the marketing of milk
CO2	To learn about the processing of butter and skim milk powder
CO3	To understand the steps involved in cheese making
CO4	To learn to prepare milk sweets
CO5	To explore the quality control methods involved

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M				L	M
	CO2	H		M		H		M			L	L	M
	CO3		M		H	H				L			M
	CO4	H			H			M	L		L	L	M
	CO5	H		M		H	L	M			L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Sukumar de, 2000, "Outlines of Dairy Technology" Oxford Univ press
2. Bhattacharya A and Rajan R P, 2002 "An over view on Yogurt, beverage and food world".

REFERENCE BOOKS

1. Andrews,2004, "Biochemistry of Milk Products" Black rabbit books, 2nd ed.
2. Ananthakrishnan C P., and Padmanabhan" The technology of milk processing" Shrilakshmi publications.

U18PEBT022	**CANCER BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology, Genetic engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological mechanisms and their applications from the

perspective of engineers

UNIT I INTRODUCTION 9

Fundamentals of Cancer Biology- Cell Cycle- regulation of cell cycle, modulation in cell cycle in cancer, Changes in signaling molecules- Effects on receptors, signal switches, Classification of stages of cancer- metasis, Metastatic cascade, common features of cancer cells, Tumor suppressor genes, Cancer genetics.

UNIT II CARCINOGENESIS 9

Principles of Carcinogenesis- Carcinogens- Targets of carcinogens, Chemical carcinogenesis, Physical carcinogenesis- X-ray radiation and radiation carcinogenesis, Viruses and Cancer, Diet and cancer

UNIT III MOLECULAR BIOLOGY OF CANCER 9

Molecular biology of cancer- Oncogenes, Identification of oncogenes, Retroviruses and oncogenes, growth factors and Growth factor receptors as oncogenes.

UNIT IV TYPES OF CANCER 9

Different sites and forms of cancer, Lung, Liver, Breast, Cervical, Blood, Prostrate, Ovarian cancers- Epidemology, causes, mutations, and features

UNIT V CANCER THERAPY 9

Cancer therapy- Cancer Immunology, Different forms of cancer therapy- Chemotherapy, radiation, Detection of cancers, advances in cancer detection and therapy, Gene therapy.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of cancer cells and its constituents
CO2	to find the environmental factors related to cancer
CO3	to know the concept of carcinogenesis and carcinogenic agents
CO4	to know the cause, symptoms, diagnosis and treatment of cancer
CO5	to give a basic knowledge of the different types of cancer

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M		H	L	L	M
	CO2	H	M	M	H	H		M	H				L
	CO3	H	M		H	H		M	M	M	L	L	
	CO4	H	M		H	H	L	M				L	H
	CO5	H	M	M	H	H		M	L	L	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lewis J.Kleismith,2006, "Principles of Cancer Biology" Pearson Benjamin Cummings.
2. Raymond W. Ruddon,2007, "Cancer Biology" Oxford University Press, 4th.

REFERENCE BOOKS

1. G.M. Cooper,2008, "Oncogenes" Jones &barlett Publisher, 1st.
2. 'Molecular Cell Biology' Darnell, Lodish& Baltimore, IV Ed,2004
3. An Introduction to cellular and Molecular Oncology- Oxford University Press, 2003
4. Genes VII and VIII – Benjamin Lewin, 2004

5. Weblink: nptel

U18PEBT023	FERTILIZER TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide basic technologies involved in food processing					

UNIT I NITROGENOUS FERTILIZER 9

Introduction – production of fertilizer- nitrogenous fertilizer, phosphatic fertilizer - feed stock materials for nitrogenous and phosphatic fertilizer.

UNIT II FERTLIZER PRODUCTS 9

Production of fertilizer products: Ammonia by steam reforming process, Nitric acid by ammonia oxidation process – Sulfuric acid by double absorption process – phosphoric acid.

UNIT III PROCESS AND STORAGE 9

Manufacturing, handling and storage of Ammonium nitrate, Ammonium sulfate, Calcium ammonium nitrate, Urea, Ammonium chloride -single super phosphate – Triple super phosphate.

UNIT IV POTASIC FERTILIZER 9

Manufacture of Potasic fertilizer – potassium sulfate – complex fertilizer – ammonium phosphate fertilizer – urea ammonium phosphate.

UNIT V BIOFERTILIZER 9

Developments in the technology of complex fertilizer production – pipe reaction – granulation process – fertilizer mixtures – biofertilizers.

TEXT BOOK

1. "Hand book on Fertilizer Technology" Tata McGraw Hill , III Ed, 2004

COURSE OUTCOMES (COs)	
CO1	To know about nitrogenous fertilizer
CO2	to understand about fertilizer products
CO3	to know about process and storage of fertilizer
CO4	to know about potassic fertilizer
CO5	to know about biofertilizer

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M				L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H			H				L	M	L		M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

PROFESSIONAL ELECTIVE III

U18PEBT031	FOOD PROCESS TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Bioprocess technology, Heat and mass transfer
	Course Designed by – Dept. of Industrial Biotechnology
OBJECTIVES: To provide basic technologies involved in food processing	

UNIT I PHYSICAL TREATMETN OF FOOD 9

Thermal, electrical and rheological properties- Heat processing- Methods of applying heat to food - sterilization - Thermo bacteriology- dehydration and drying - free moisture - equilibrium moisture content- water activity- classification of dryers- tray, and freeze dryers, osmotic dehydration - foam mat drying- extrusion coking.

UNIT II BLENDING METHODS 9

Mixing of solids, Pastes and liquids - Characteristics of mixtures-Blending -emulsification-equipments - liquid, pastes, and plastic masses - dry powders - criteria of mixer effectiveness-mixing index

UNIT III PRESERVATION OF FOOD 9

Concentration - freeze concentration - freezing and storage of frozen products - low temperature preservation - irradiation of food products - microwave heating - dielectric heating of foods.

UNIT IV DAIRY FOODS 9

Physics and chemical properties of milk and their effect on design - heaters - coolers -heat exchange equipments - storage tanks - can washers - pasteurization - principles and methods - equipments - LTLT - HTST - UHT pasteurization - CIP unit -Homogenization - Theory and working of homogenizers - bottle fillers and cappers -cream separation - principles - types of separator - classifiers - butter churns - cheese plant equipments - ice cream freezers - drying equipments - drum drier and spray drier -membrane concentration equipments.

UNIT V FOOD MICROBIOLOGY 9

Food microbiology: food spoilage, food borne diseases, infections, intoxifications, utilization of microorganisms in food industries, Nutraceuticals. Quality control, Case studies on biotechnology in the evaluation of food quality.

COURSE OUTCOMES (COs)	
CO1	To know about preservation techniques
CO2	to understand basic concepts in sterilization of food products
CO3	to know about various dryers
CO4	to know about the mixing equipment for various products
CO5	to know about various preservation techniques for food products

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	L	M	L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lehninger and Beverlov, 2002, “Food Process Engineering”. Reidal Publishing Co. Holland
2. Yin H.Hui, 2006, “Handbook of food science, technology and engineering” Wiley, New York, 2nd ed

REFERENCE BOOKS

1. Tucker & Woods, 1995, “Enzymes in food processing” Springer, 5th ed.
2. Hamm &Hammilton, 2000, “Edible oil processing” Academic Press 5th ed
3. Fellows, 2009, “Food processing technology” 21th ed
4. Heldman, 2007,”Hand book of food engineering” CRC Press 2nd ed
5. P.G. Smith, 2003, “Food Process Engineering” Academic Plenum Pub, New York 1st ed
6. Srilakshmi,2005, “Food Science” MJP Publiashers, 3rd ed
7. Weblink: nptel

U18PEBT032	PROTEOGENOMICS AND BIOINFORMATICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioorganic chemistry, Basic Biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers

UNIT I BIO INFORMATICS **9**

Introduction to bioinformatics – Biological Databases,-Sequence databases-Structural databases – Data mining and Applications –Sequence Database search – FASTA – BLAST.

UNIT II GENOMICS **9**

Genome – Organization ofEukaryotic genome – Mapping strategies – Genetic mapping and physical mapping – Genome mapping – Human genome project – Gene expression – Microarrays

UNIT III SEQUENCE TECHNOLOGIES **9**

Alignment of multiple sequences – Methods and applications – Tools for sequence alignment. Gene identification Methods and applications – Tools for gene prediction – Methods and applications

UNIT IV PROTEOMICS **9**

Lifecycle of protein – Classification and structure visualization techniques – Protein databases – Prediction of primary and secondary structure – Prediction of 2D and 3D structure

UNIT V TOOLS OF PROTEOMICS **9**

Separation of proteins by SDS-PAGE, IEF – Mass spectrometry –MALDITOF – Peptide mass finger printing – Peptide sequence analysis – SALSA and TMS.

COURSE OUTCOMES (COs)	
CO1	to understand the classification of biological databases and its role in research
CO2	to apply the concept of genomics of different organism, gene expression and mapping situations
CO3	to know the tools for gene identification and prediction
CO4	to know the structural elucidation and prediction of proteins
CO5	to get a basic knowledge of techniques related to proteomics
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	M		L	L	M
	CO4	H	M		H	H		M		M	L	L	M
	CO5	H	M	M	H	H		M	L		L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. S.C. Rastogi, 2007, "Bioinformatics methods and applications ", Prentice – Hall of India Publication

REFERENCE BOOK

1. Lesk AM, 2007, "Introduction to Genomics", Oxford University Press, IV Ed.
2. Brownstein M.J, 2003, "Functional genomics methods and protocols", Humana Press, III ed.

U18PEBT033	WASTE MANAGEMENT TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic of waste and its disposal				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To give a basic knowledge of waste handling and utilization

UNIT I INTRODUCTION 9

Introduction: Definition and Classification- Disposal methods: Land fill and Incineration – Recycling methods: biological reprocessing and Energy recovery-. Avoidance and Reduction Methods- Waste handling and Transport – Waste management Concepts

UNIT II AGRICULTURAL WASTE 9

Introduction- Waste Consistency- Waste Management Function: Production ,Collection, Storage, Treatment , Transfer, Utilization- Waste Management system Design – Waste Management System: Dairy Waste, Beef Waste, Swine Waste, Poultry Waste, Other animal – Municipal and Industrial Sludge- Food Processing – Agri-Chemical Waste Management- Handling.

UNIT III BIOMEDICAL WASTE 9

Introduction- Overview – Characterization of Medical Waste- Waste Generation Methodology – Sterilization- Chemical Disinfection – Thermal Inactivation- Irradiation- Microwave Treatment – Grinding and Shredding – Compaction- Current Practice – Standards .

UNIT IV INDUSTRIAL WASTE MANAGEMENT 9

Paper and Pulp Industry – Leather Industry – Cement Industry – Chemical Industry – fertilizer Industry – Pharmaceutical Industry – Textile industry – Iron and Steel industry – Mining Industry – Lignite industry – Petroleum Industry – Nuclear Industry.

UNIT V REMEDIAL MEASURES 9

Bioremediation – Phyto-remediation- Recycling of Plastic and Paper

COURSE OUTCOMES (COs)	
CO1	to understand the various types of waste
CO2	to know the various technologies to handle the waste material

CO3	to know the remedial measures for waste disposal												
CO4	To get idea about industrial waste management												
CO5	To know about bioremediation of waste												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

REFERENCE BOOKS

1. Agricultural Waste Management Hand Book by USDA, III Ed,2005
2. Industrial Biotechnology Problems and Remedies by InduShekhar Thakur, VI Ed,2006

PROFESSIONAL ELECTIVE IV

	FOOD SAFETY AND QUALITY CONTROL	L	T	P	C
U18PEBT041	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Food process engineering, Microbiology, Bioprocess Engineering, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To know about the safety regulations of food industries					

UNIT I FOOD SAFETY REGULATIONS 9

History of food regulations in India- Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973),Edible Oils Packaging, 1998, Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

UNIT II FOOD SAFETY MANAGEMENT 9

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

UNIT III FOOD QUALITY MANAGEMENT 9

Principles of food quality assurance, total quality management (TQM)–good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

UNIT IV MICROBIAL CONTAMINATION 9

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry Food safety and Standards Act 2006: salient provision and prospects

UNIT V FOOD SAFETY STANDARDS 9

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarious commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

COURSE OUTCOMES (COs)													
CO1	To study the history of food safety regulations												
CO2	to know about food adulteration												
CO3	to understand about food management practices												
CO4	to get basic idea about food hygiene												
CO5	to get basic idea about microbial quality control												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. V. K. Kaushik (1999),Nutrition And Food Safety, Neha Publishers
2. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

REFERENCE BOOKS

1. Andre, Gordan (2015), Food Safety and Quality Systems in Developing Countries, Elsevier
2. YasmineMotarjemi(2013), Food Safety Management, 1st Edition, Elsevier.

U18PEBT042	**STEM CELL AND TISSUE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Animal Biotechnology, G3enetic Engineering, Molecular Biology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of stem cells and their applications from the perspective of engineers					

UNIT I ORIGIN AND CHARACTERISTICS OF HUMAN STEM CELLS 9

Origin and characteristics of human stem cell, plasticity of human somatic stem cells research, Novel stem cell based therapies, Scientific and technical obstacles to overcome before realizing the potential clinical uses of novel human stem cell based therapy, Cord blood,-Stem cell marker.

UNIT II HUMAN EMBRYONIC STEM CELL RESEARCH 9

Possible sources for human embryonic stem cell, growing human ESC in laboratory, Current advantages and limitations of hESC and human somatic cells-Examining the need for new hES cell lines, Developments regarding establishment of human stem cell banks and registries.

UNIT III ISOLATION AND IDENTIFICATION OF STEM CELLS 9

Preparation of complete human neuroculture, Culturing and subculturing human neurospheres, Differentiation of cells from human, neurospheres into neurons, astrocytes and oligodendrocytes; Immunolabelling procedures

UNIT IV GENE THERAPY 9

Possibilities to overcome immuno-rejection responses in stem cell therapy, Haematopoietic stem cell transplantation - A new therapy for autoimmune disease, Prenatal diagnosis of genetic abnormalities using fetal CD34+ stem cells, Stem cells in treatment for major diseases and reparative medicine, ESC a promising tool for cell replacement therapy, germ line therapy.

UNIT V TISSUE ENGINEERING 9

Basic principles and consideration - Cell type and source, Metabolic requirements of cells, Reconstruction of connective tissues, Reconstruction of epithelial or endothelial surfaces - cells embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Bioreactor design on tissue engineering - Hollow fiber systems, Microcarrier based systems-Tissue engineering of the liver.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of stem cells and its types												
CO2	to apply the techniques for preservation of stem cells												
CO3	to give the information about embryonic stem cell research												
CO4	to know the role of stem cells in medicine												
CO5	to get a basic knowledge of the applications of stem cells in gene therapy												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	L		L		M
	CO2	H	M	M	H	H		M		H	L	L	M
	CO3	H	M		H	H		M				L	M
	CO4	H	M		H	H			H		L	L	
	CO5	H	M	M	H	H		M		M		L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. R.C.Dubey, 2004, "Text book of Biotechnology" 3rd Ed.

REFERENCE BOOKS

1. SudhaGangal , 2002, "Principles and Practice of Animal tissue culture", IV Ed
2. P. Ramadass , 2008, " Animal Biotechnology" MJP pub.
3. Weblink: nptel

U18PEBT043	**BIOFUEL TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Bioprocess				

	Course Designed by – Dept of Industrial Biotechnology

OBJECTIVES:

To provide a basic understanding of fuel and biofuel concepts and its production techniques

UNIT I INTRODUCTION 9

Introduction – Potential of biomass – biofuel policies: Policy in EU – Biofuel standardization – International Trade of biofuel-Biofuel Life Cycle – Energy balance -& Efficiency of biofuel – Biofuel emission: Greenhouse gas emission – Vehicle emission standards – other environmental Impacts of Biofuel – economy of biofuel – Consideration of Co-Products.

UNIT II BIOETHANOL 9

BioEthanol – Feed stock production: sugar Crops, Starch crops , Cellulosic feed stock – Bioethanol Production : Sugar to ethanol Process, Starch to ethanol process, Cellulose to Ethanol Process – Distillation & Dehydration process – Properties – Application –standardization – Energy balance – Bioethanol Emission : Greenhouse gas emission, toxic exhaust emission – Other environmental impacts: water issues, land use & biodiversity, human Health.

UNIT III LIPID BIOFUELS 9

Lipid derived Biofuel – Feed stock production -: Oil seed crops, Micro algae , Animal fats, waste oils – Fuel production : Oil Extraction , Oil Refining, Transesterification – Properties & Use : Properties of Pure Plant Oil (PPO) , Properties of Biodiesel – Application – Energy balance – Emissions of lipid biofuel – Other Environmental Impacts – Economy.

UNITIV BtL FUELS 9

BtL Fuel: Feed Stock production – BtL production – Gasification, Gas Cleaning – Synthesis process-Biohydrogen: Processing – Use – The Future of Biofuel.

UNIT V BIOMETHANE 9

Biomethane – Feed stock Production- BioMethane Production : Digestion Process- Digester types- biogas Purification – Properties & Use – Application – Standardization – BioMethane Emission – Other Environmental Effects – Economy.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biofuel
CO2	to know the various source for biofuel
CO3	to apply the technique in large scale
CO4	to study about lipid derived biofuel
CO5	to give a basic knowledge of the applications biofuel

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		M		H		L	M	M
	CO2	H	M	M	H	H		M		H			
	CO3	H	M		H	H		M	M		M	L	M
	CO4	H	M		H		M	M		H			
	CO5	H	M	M	H	H			M			M	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. DominikRutz& Rainer Janssen, 2007, “Hand Book on BioFuel Technology”, II ED.

REFERENCE BOOKS

1. SoetaertErlckI. Vandamme, 2009, “Biofuels” John Wiley & Sons, 1st.ed.

2. Hand Book on " BioFuel Technology" by DominikRutz& Rainer Janssen, 2007
3. "Bioprocess technology" – P.T. Kalaichelvan and I. Arul Pandi. 2007. MJP Pub.
4. CayeDrapcho, John Nghiem, Terry Warker, 2007, "Biofuel Engg& Process Technology" Mc-Graw Hill, 1st ed

PROFESSIONAL ELECTIVE V

U18PEBT051	**BIOREACTOR DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Fermentation Techniques, Chemical reaction engineering, Bioprocess engineering				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES To provide knowledge about the designing of reactor					

UNIT I REACTOR ENGINEERING 9

Reactor engineering in Perspective- Mechanical aspect of bioreactor design: Guidelines for configurations:- Batch Bioreactor- Fluidized bed reactor- Air lift bioreactor- Trickle bed bioreactor- Hollow fibre reactor- and wave bioreactor (Disposable bioreactor) Practical considerations for bioreactor construction

UNIT II BIOREACTORS AND DESIGN CONSIDERATIONS 9

Batch reactors; Continuous Stirred Tank Bioreactors (Chemostat); Enzyme Catalysis in Chemostat; Age Distribution Models; Fed Batch Reactors; Recycle Systems, Design of airlift bioreactors

UNIT IIISELECTION, SCALE-UP, OPERATION AND CONTROL 9

Process scale up - general considerations-Simple calculation for scale up and scale down.Strategies for bioreactor design for cost-determining factors

Fermentation Control Introduction to control: control loop, analogue and digital control, control algorithm-PID control, time-proportional control. Physical control of fermentation

UNIT IV MODELING AND SIMULATION OF FERMENTATION PROCESSES 9

Unstructured Non-Segregated Model-substrate limited growth-Models with growth inhibitors-Logistic equation-growth models for filamentous organism.

Modeling, digital simulation, digital simulation programming languages, ISIM(interactive simulation language)

UNIT V PLANT AND ANIMAL CELL BIOREACTORS 9

Introduction, plant cells: plant cell bioreactors, characteristics of plant cell suspensions, plant cell bioreactor requirements, plant cell bioreactor design, plant cell bioreactor operation, alternative cultures for plant cells. Animal cells: Animal cell bioreactors, animal cell bioreactor operation, animal cell bioreactor design

TEXT BOOKS

1.MichaelL.Shuler&Fikret Kargi.,2008,"Bioprocess Engineering",Editedby,Prentice-Hall of India Pvt New Delhi

2.Paulin M. Doran.,2011," Bioprocess Engineering Principles",Academic Press

REFERENCE BOOKS

1. Scragg A.H.,2002, "Bioreactors in Biotechnology", Edited by, Ellis Horwood Limited, England
2. Bailey and Ollis, 2000, "Biochemical Engineering Fundamentals", McGraw Hill 3rd ed.

3. Stanbury PF,1984, “Principles of fermentation technology” SS Hall, 2nd.
4. Mansi El Mansi.2003 “Fermentation Microbiology & Biotechnology”.IVEd.
Weblink: nptel

U18PEBT052	DEVELOPMENTAL BIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES:
To provide basic knowledge about biology of human system
To provide knowledge about the designing of reactor

UNIT I INTRODUCTION **9**

Developmental biology: its scope, history and special fields-Germ cells: origin of germ cells, its migration and fate-Spermatogenesis: cells in seminiferous tubes, spermiotelosis, nuclear control of spermiotelosis, ultramicroscopic structure of mammalian sperm, types of sperm.

UNIT II OOGENESIS **9**

Oogenesis: growth of oocyte, maturation of ovum, formation of yolk, accessory cells, egg cortex and its importance, egg membrane-Fertilization: significance of sperm-egg interaction, acrosome reaction, sperm penetration, behaviour of pronuclei, syngamy, polyspermy, activation of egg-Parthenogenesis: natural and artificial.

UNIT III CLEAVAGE **9**

Cleavage: definition, early history and concept, geometry of cleavage, types of cleavage, cleavage patterns and factors governing them, laws of cleavage, theories of cytokinesis-Gastrulation: morphogenetic movements, selective affinity and adhesiveness of cells, mechanism of the change of shape of cell during morphogenesis-Embryonic induction: Spemann's primary organizer, nature of induction mechanism of action of inducing substances.

UNIT IV EMBRYO DEVELOPMENT **9**

Organization of the early embryo: polarity, symmetry, regulative development and physiological gradients, mosaic development- Differentiation: equivalence of nuclei, cytoplasmic control of nuclear activity, genetic control of differentiation, isozymes, mass effects-Metamorphosis: insect metamorphosis, amphibian metamorphosis, metamorphosis and evolution.

UNIT V REGENERATION OF TISSUES AND ORGANS **9**

Regeneration: regeneration in amphibians and planarian, stimulation and suppression of regeneration, histological processes concerned in regeneration, gradient concept, neural and endocrine influences- Developmental aspects of immunology- Teratology: factors inducing abnormal development of tissues and organs.

COURSE OUTCOMES (COs)	
CO1	to understand the history and scope of developmental biology
CO2	to know about fertilization
CO3	to know basic concepts on cleavage
CO4	to know about regeneration
CO5	to study the various processes involved in regeneration
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M		H	M		H	H		L	L	
	CO2	H		M	H	H				M	L		
	CO3		M			H		M				L	M
	CO4	H			H		L				M	L	M
	CO5		M	M	H	H		M	M		L		
3	Category	PE											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. B. Balinsky 2004, "An introduction to embryology", 5th ed.

REFERENCES

1. J. Brachet, 2003, "Introduction to molecular embryology".
2. N.J. Berrill, 2005, "Developmental biology".
3. Gene activity in early development, (2005), H. Davidson

U18PEBT053	**INDUSTRIAL WASTE TREATMENT AND DISPOSAL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Environmental biotechnology, Waste management				
	Course Designed by – Dept of Civil Engineering				

OBJECTIVES

To provide knowledge on sources and characteristics of industrial wastewater, techniques and approaches for minimizing the generation and application of physio chemical and biological treatment methods for recovery, reuse and disposal

UNIT I INTRODUCTION 9

Effects of industrial wastes on streams, land and air, waste water treatment plants, water quality criteria – effluent standards : Process modification, method and material changes, housekeeping etc., to reduce water discharges and strength of the waste and established recovery methods for bye products within the plant operations.

UNIT II CHARACTERISTICS OF WASTE 9

Characteristics of major industrial waste water (liquid wastes) Chemical Industries: Petrochemicals & refineries, pharmaceuticals. Apparel Industries: Textile, synthetic fibres, leather, paper-Agro Industries: Fertilizer Food Industries: Heat – packing pickles, canning poultry and eggs, distillers, sugar. Metallurgical Industries: Thermal power station, nuclear power plants.

UNIT III WASTE TREATMENT 9

Conventional methods of treatment and disposal of industrial wastes-Equalization and neutralization, separation of solids – sedimentation and filtrations

UNIT IV BIOLOGICAL TREATMENT 9

Removal of organic contents: Biological treatment methods, aerobic and anaerobic, digestion, tickling filters, stabilization ponds, activated sludge process – oxidation ditch.

UNIT V PHYSICOCHEMICAL TREATMENT 9

Physico Chemical Treatment Method – Neutralization, coagulation, flocculation, adsorption and precipitation. Combined treatment of industrial and municipal wastes.

COURSE OUTCOMES (COs)	
CO1	Have a fundamental knowledge of the effluent discharge standards and waste minimization technology
CO2	Have a well-founded knowledge of characteristics of industrial wastewaterand treatment methods
CO3	Acquire knowledge about conventional methods of treatment for industrial waste
CO4	Understand various biological treatment methods
CO5	Have a fundamental knowledge of combined treatment of industrial and municipal wastes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M	H	M	L		L	L	M
	CO2	H	M	M	H	H	H	M		H	L	L	M
	CO3	H	M		H	H	M	M	H		L	L	M
	CO4	H	M		H		H	M	M	M	L	L	M
	CO5	H	M	M	H	H	M	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. EckenfalderW.W,"Industrial Water Pollution Control", McGraw Hill, New York, 1989

REFERENCE BOOKS

1. Arceivala S.J &ShyamAsolekarR,"Waste Water Treatment and Pollution Control Tata McGraw Hill, 1998.
2. Nelson Leonard Nemerow, "Theories and practice of industrial waste treatment", Addison Wesley Pub. Co., 1963
3. World Bank Group "Pollution prevention and Treatment Hand Book" World Bank and UNEP Washington DC, 1998

PROFESSIONAL ELECTIVE VI

U18PEBT061	**FERMENTATION TECHNOLOGY AND APPLICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Process engineering in biotechnology, Microbiology				
	Course Designed by – Dept. of Agricultural Biotechnology				

OBJECTIVES:

To provide a basic knowledge of Biological processes.

UNIT I INTROCTION TO FERMENTATION

History of fermentation - medium optimization - Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.

UNIT II INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO_2- cell mass, cell number, solid-substrate fermentation and its applications.

UNIT III FERMENTATION TECHNIQUES 9

Fermentation- Definition & types - Submerged and Solid state. Fermentors& its types (Tower, cylindroconical& airlift) – Batch fermentation – Continuous fermentation.

UNIT IV FERMETATION PRODUCT 9

Production of beverages – beer and wine- vitamin B12–Antibiotics- penicillin - Bakers yeast, Details of mushroom development-Oyster (Pleurotus) and Button (Agaricus) mushroom.

UNIT V DOWNSTREAM PROCESSING 9

Downstream process- Intercellular and extracellular- Centrifugation, filtration, Floatation-solvent extraction, precipitation- cell disruption- physical and Chemical methods.

COURSE OUTCOMES (COs)													
CO1	To understand the development of bioprocess techniques.												
CO2	To know about the instrumentation and control for bioprocess operations												
CO3	To get idea about media formulations												
CO4	To know about stoichiometry of bioprocess.												
CO5	To know about various bioreactors												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H			L	L	
	CO2	H	M	M	H	H		M		M	L		M
	CO3	H			H	H	M	H	H			L	M
	CO4	H	M		H			M			L		
	CO5	H	M	M	H	H		M	M	M	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Stanbury P T and Whitaker 1984, Principles of Fermentation Technology,
Pergamon Press. NY

REFERENCE BOOKS

1. Casida, L E JR 1968 Industrial Microbiology. New Age International Publishers.
2. Prescott and Rehm 1979. Industrial Microbiology.Wiley and Sons.

U18PEBT062	**BIOPHARMACEUTICAL TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Bioorganic chemistry, Basic biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES:					

To provide a basic understanding of pharmaceutics and their applications from the perspective of engineers

UNIT I INTRODUCTION **9**

Introduction to bio pharmaceutics – Various route of drug administration- drug absorption, factors influencing drug absorption from the gastrointestinal tract.

UNIT II FORMULATION OF DRUGS **9**

Manufacturing Principles - Compressed tablets - wet granulation - Dry granulation or slugging - Direct compression - Tablet presses formulation - Coating - Pills - Capsules - Parental solutions - injections

UNIT III PHARMACODYNAMICS **9**

Binding of drugs to blood components - tissue binding of drugs - factors affecting protein drug binding - significance of protein/tissue binding of drugs - kinetics of protein-drug binding

UNIT IV BIOTRANSFORMATION **9**

Biotransformation - drug metabolizing enzymes - phase I reactions - phase II reactions - first pass effect - factors affecting biotransformation of drugs - bio activation and tissue toxicity.

UNITV PRODRUGS **9**

Bio precursor prodrugs - carrier prodrugs - application of prodrug design: - enhancement of bioavailability - site specific drug delivery - limitations of prodrug design.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of drugs and its absorption
CO2	to know the manufacturing process of drugs and its bioavailability
CO3	to comprehend drugs and its binding mechanism
CO4	to know the drug metabolism and biotransformation
CO5	to get a basic knowledge of the applications of prodrugs in biological systems

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	L	L	
	CO2	H	M	M	H	H					H	L	M
	CO3	H	M		H	H		M	M	M	M		M
	CO4	H	M			H		M				L	
	CO5	H	M	M	H	H		M	L	L			M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Brahmankar, D.M. "Biopharmaceutical and pharmacokinetics: A Treatise", VallabhPrakashan, 1995.

REFERENCE BOOKS

1. Remington's Pharmaceutical Sciences, Mack Publishing and Co.,
2. Weblink: nptel

U18PEBT063	**BIOREMEDIATION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Bioprocess technology, Microbiology
	Course Designed by – Dept. of Industrial Biotechnology

OBJECTIVES:
To provide basic knowledge about the bioremediation techniques

UNIT I BIOREMEDIATION **9**

Types of Bioremediation, Factors affection Bioremediation.Bioremediation Mechanisms.Limitations of Bioremediations. Microbes for Bioremediation :EssentialChararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques :Insitu&Exsitu bioremediation techniques. Phytoremediation

UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES **9**

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation.

UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS **9**

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

UNIT IV NUCLEAR WASTE BIOREMEDIATION **9**

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION **9**

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance &tolerance ;Microbial transformation; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – Biosurfactants. Advantages of biosurfactants over chemical surfactants- Biotechnology and oil spills; Improved oil recovery.

COURSE OUTCOMES (COs)	
CO1	To know about the types of bioremediation
CO2	to understand basic techniques in bioremediation
CO3	to know about bioremediation of chlorinated compounds
CO4	to know about the nuclear waste bioremediation
CO5	to know about remediation of oil spills

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	L	M	L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

REFERENCE BOOKS

1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles andApplications"* McGraw-Hill, 2001.
2. Phillip L. Buckingham , Jeffrey C. Evans,"*Hazardous Waste Management"* Waveland PrInc; Reissue edition 1, 2010.
3. S. K. Agarwal, *"Environmental Biotechnology*", APH Publishing, 2000
4. Martin Alexander, "*Biodegradation & Bioremediation"*, Academic press, 1999.
5. Karrely D., Chakrabarty K., Omen G.S, "*Biotechnology and Biodegradation*", Portfolio Pub. Co., 1990.
6. P. Rajendran, P. Guansekaran, "*Microbial Bioremediation*", Mjp Publishers, 2011.

OPEN ELECTIVE OFFERED BY THE DEPARTMENT OF IBT FOR OTHER DEPARTMENT

	CHEMICAL PROCESS INDUSTRIES	L	T	P	C
U18OEBT001	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Bioprocess Engineering, Principles of chemical engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of chemical process industries

UNIT IFERTILIZER AND BIOFERTILIZER INDUSTRIES 9

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries - Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate- Biofertilizer.

UNIT II PULP AND PAPER INDUSTRIES 9

Pulp – Methods of production: sulphite and sulphate- Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production- wet process.

UNIT III SUGAR AND STARCH INDUSTRIES 9

Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivatives: dextrin.

UNIT V OIL, SOAPS AND DETERGENTS INDUSTRIES 9

Oil- constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils- Soap: definitions- continuous process for the production of fatty acids, glycerine and soap- production of detergents- Enzymes in detergent.

UNIT V DYES AND PIGMENT INDUSTRIES 9

Introduction- types of dyes- classification-Production: azo dyes, natural dye- Pigments

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of process industries
CO2	to apply the concept biotechnology in process
CO3	to classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers.
CO4	to know the production processes

CO5	to know the biotechnology processes												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

production.

TEXT BOOK

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001. 1

REFERENCE BOOKS

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
2. SrikumarKoyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd

U18OEBT002	**BIOPROCESS ECONOMICS AND PLANT DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite – Basic Biotechnology, Chemical Reaction Engineering, Bioreactors				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide knowledge about process economics and plant design

UNIT I PROCESS DESIGN DEVELOPMENT 9

Technical feasibility survey, process development, flow diagrams, equipment design and specifications

UNIT II GENERAL DESIGN CONSIDERATION 9

Marketability of the product, availability of technology, raw materials, equipment, human resources, land and utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production cost.

UNIT III COST ESTIMATION 9

Capital investment-fixed capital investments including land, building, equipment and utilities, installation cost(including equipment, instrumentation, piping, electrical installation and other utilities), working capital investment.

UNIT IV COST ESTIMATION 9

Manufacturing costs-Direct Production cost(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties etc) fixed charges (including depreciation, taxes insurance, rental cost etc).,

UNIT V LIABILITIES 9

Plant overheads-Administration, safety and auxiliary services, payroll overheads, ware house and storage facilities etc. Profitability Analysis-return on original investment, interest rate of return, accounting for uncertainty and variations and future developments- Optimization techniques-Linear and Dynamic programming, Optimization strategies

COURSE OUTCOMES (COs)	
CO1	To understand basic principles of process design
CO2	To know about marketing of products
CO3	To know about capital and fixed cost
CO4	To study the cost involved in human resources
CO5	To understand about the administration of a plant

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L		
	CO2	H	M	M	H	H		M		M		L	M
	CO3	H	M		H	H		M	M		L		
	CO4	H	M		H	H	L	M			L	L	M
	CO5	H	M	M	H	H		M				L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Peters and Timmerhaus, "Plant design and Economics for Chemical Engineers ",McGraw Hill 4th Edition, 2002.

REFERENCES BOOKS

1. Rudd and Watson, "Strategy of Process Engineering ", Wiley, 2003.

U18OEBT003	**BREWING TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Principles of Bioprocess Technology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To give in depth knowledge on Beer Production

UNIT I OUTLINE OF BREWING **9**

Introduction – Malts – Brewing liquors – Milling and Mashing- Processing of Beer – types of beer – malting – water, effluents and wastes.

UNIT II SCIENCE OF MASHING **9**

Introduction – Mashing schedules – Altering Mashing Conditions – Mashing Biochemistry – Mashing and Beer flavour – Spent Grains – Preparation of grists – Mashing technology.

UNIT III WORT BOILING **9**

Introduction – Chemistry of wort boiling – Clarification, Cooling and Aeration.

UNIT IV WORT FERMENTATION **9**

Basic principles – Bottom and top Fermentation Systems – Continuous Fermentation – Fermentation Control Systems, Beer Maturation– flavour and aroma changes - Stabilization against nonbiological haze – Carbonation – Clarification and filtration – Special beer treatments.

UNIT V CHEMICAL AND PHYSICAL PROPERTIES OF BEER 9

Chemical Composition – Nutritive value – Colour – Haze – Viscosity – foam Characteristics – gurtingflavour – Semors analysis – Packaging.

COURSE OUTCOMES (COs)													
CO1	To make the students to understand brewing												
CO2	To know about wort boiling												
CO3	To know about mashing												
CO4	To make the students to get knowledge about wort fermentation												
CO5	To make them to understand the physical and chemical properties of beer and packaging												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		M
	CO2	H			H	H		M		M	L	L	
	CO3		M				H		H			L	M
	CO4	H			H			M		M	L		
	CO5		M	M			M	M	H			L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK:

1. Brewing – Science and Practice by Dennis E. Briggs, Chris A. Boulton, Peter A. Brookers and Roger Sterens, Wood head Publishing Limited, 2004.

U18OEBT004	**BIOMINING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Bioprocess, Microbiology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To create basic awareness about biomining

UNIT I BIOLEACHING 9

Introduction, Copper processing technologies- in situ leaching, smelting, concentrate leaching, Heap and dump leaching. Thermophilic Heap bioleaching – Basic heap design and importance of heat generation, sulfur availability, microbial activity, inoculation, pH, inhibitory factors, heat retention, air-flow rate and irrigation rate.

UNIT II GEOBIOTICS 9

Introduction, the GEOCOAT AND GEOLEACH technologies, complementary Geobiotics technologies, the GEOCOAT process, advantages of the GEOCOAT process, the Agnes mine GEOCOAT project, developing technologies.

UNIT III BIOMINING MICROORGANISMS 9

Introduction, Biooxidation of minerals, General chemistry of mineral biooxidation, advantages of biooxidation, types of organisms, general physiology of mineral-degrading bacteria, autotrophy, nitrogen, phosphate and trace elements. Energy production- iron, sulfur oxidation, adaptability of biomining microorganisms, metal tolerance and resistance.

UNIT IV ACIDOPHILIC MICROORGANISMS 9

Biodiversity of acidophilic microorganisms, techniques for detecting and quantifying microbial life in mineral oxidizing environments, cultivation dependent approaches, PCR based microbial identification and community analysis, PCR independent molecular detection and identification of acidophiles, future perspectives on molecular techniques for detection and identification of acidophiles.

UNIT V GENETICS OF BIOLEACHING 9

Introduction, relevant biochemical and chemical reactions, Genetics of bioleaching microorganisms, Iron and sulfur oxidation and reduction in Acidithiobacillusferrooxidans, sulfur oxidation, ferric iron and sulfur reduction in Acidiothiobacillusferrooxidans. Iron oxidation in other bioleaching microorganisms – Ferroplasma spp., Leptospirillumspp, Metallosphaerasedula, sulfur oxidation in other bioleaching microorganisms.

COURSE OUTCOMES (COs)													
CO1	To introduce biomining												
CO2	To know basics of geobiotics												
CO3	To create complete knowledge about the bioleaching of copper												
CO4	To learn about biodiversity microorganisms												
CO5	To know about bioleaching microorganisms												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		M
	CO2	H			H	H		M		M	L	L	
	CO3		M				H		H			L	M
	CO4	H			H			M		M	L		
	CO5		M	M			M	M	H			L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. NaginaParmar and Ajay Singh, "Geomicrobiology and Biogeochemistry" Spinger publications.

REFERENCE BOOK

1. Douglas E. Rawlings, D. Barrie Johnson, "Biomining" Springer Science & Business Media, 18-Dec-2006.

U18OEBT005	**INDUSTRIAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess, Enzyme Engineering & Technology, Basic Biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge about Safety engineering

UNIT I INDUSTRIAL HAZARDS 9

Safety in Process Plants – Hazard Analysis – Types of Hazard – hazard Identification techniques Hazard Evaluation – Important Factories Act.

UNIT II CHEMICAL HAZARD 9

Hazards in work place: safety in the use of chemicals at work – Chemical hazard - Air-Borne Contaminants – particulate matter – Hazard and safety methods – hazards and Safety measures in Refineries , Paper and Pulp Industries- Safety Conditions in tanneries –Hazards of Pesticide – Sugar industry.

UNIT III SAFETY MANAGEMENT AND FIRE SAFETY 9

Introduction- Safety policy- Safety in electrical installation: Electrical shock and prevention-safety precautions for residential and commercial installation - Case study-Four stages of Fire-types of Fire Detectors – Fire safety in Industry – chemistry of fire- Types of Combustion- Fire Triangle- Fire extinguishing Technique – Engineering consideration for safety consideration

UNIT IV INDUSTRIAL ACCIDENTS 9

Industrial accidents – Classification – prevention – accident cost – Steps of investigation – Analysis of Accidents – Remedial Measures – Methods of Prevention – Safety Slogans – Case study

UNIT V PROTECTIVE EQUIPMENTS 9

Personal protective Equipment and personal Protection – Aim – Need – Types: Non Respiratory Protective equipment- Respiratory typeFirst aid – principles and methods – First aid training – Scope of first aid – Golden rules– First aid treatment : for wounds and Hemorrage , Shock , respiration :Schafer's Method, Shock. Fractures, Burns and Scalds, Unconsciousness, Heat exhaustion and Stroke– First aid Kit box A and B.

COURSE OUTCOMES (COs)													
CO1	to understand basic concepts in hazard analysis												
CO2	to know about safety and its management												
CO3	to know about accidents and its preventive measures												
CO4	to understand various personal protective equipment and first aid												
CO5	to know about personal protective equipment												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	M		L		M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		M	L	L	M
	CO4	H	M		H	H		M	L		L	L	
	CO5	H	M	M	H	H		M		L	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Nicholas, 2008, "Practical Guidance to Industrial Safety" 3rd ed
2. Prof.M.H.Fulekar, 2007, "Industrial Hygiene & chemical Safety" 2nd ed

REFERENCE BOOKS

1. Rudd,2005, "Strategy of process engineering" Willey
2. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

U18OEBT006	BIODIVERSITY MANAGEMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite- Botany, Environmental studies				
	Course Designed by – Department of Industrial biotechnology				

OBJECTIVES

To learn about the conservation of biodiversity

UNIT I TYPES, FUNCTIONS AND BENEFITS OF BIODIVERSITY 9

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Megadiversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - Use of Biodiversity: Source of food, medicine, raw material, aesthetic and cultural uses – Biodiversity Prospecting: Significance of Indigenous Knowledge Systems

UNIT II THREATS TO BIODIVERSITY 9

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

UNIT III CONSERVATION STRATEGIES 9

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agro-forestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies

UNIT IV SUSTAINABLE MANAGEMENT OF BIORESOURCES 9

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

UNIT V POLICIES, PROGRAMMES AND ACTS FOR CONSERVATION 9

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration

COURSE OUTCOMES (COs)	
CO1	to understand what is diversity
CO2	to learn about the threats to diversity
CO3	to know the methods of conservation of diversity
CO4	to learn the sustainable methods of diversity
CO5	to have a knowledge about various policies

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H	M		H	M		M	M		L		M
	CO2	H	M	M		H		M			L	L	
	CO3				H	H				M	L	L	M
	CO4	H	M		H				L		L	L	
	CO5	H	M	M	H	H		M		L	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT/REFERENCE BOOK

1. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
2. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
3. Kumar HD (1997) General Ecology. Vikas Publishing House (P) Ltd., New Delhi.
4. Muthuchelian K (2013) UyirVirimam (Tamil), PranishaPathippagam, Madurai.
5. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.
6. Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.

Web References

1. www.iucn.org
2. www.cites.org
3. www.cbd.int
4. www.fao.org/Ag/agp/agpc/doc/Publicat/TAPAFON/TAP_7.pdf
5. www.wri.org/biodiv/bp-home.html

CURRICULUM AND SYLLABUS (R2018)

B-FACT

(Applicable to the students admitted from July 2018)

B.TECH – BIO TECHNOLOGY SPECIALIZATION IN AGRICULTURAL BIOTECHNOLOGY

I – VIII SEMESTERS

SEMESTER I								
S. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Mathematics –I for Bio Engineering	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
8	*U18BSPH2L3	BS	Waves and Optics and Biophysics Lab	3	0	0	3	0
9	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
PHYSICAL ACTIVITY BASED COURSES								
10	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
Total				35	15	1	19	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**
The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER II								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA202	BS	Mathematics- II for Bio	4	3	1	0	4

			Engineering					
3	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
4	U18BSGE201	ES	Cytology And Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18MCTH201	MC	Environmental Sciences	3	3	0	0	3
PRACTICAL								
7	*U18BSPH 2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
8	*U18BSCH 2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
PHYSICAL ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	14	2	20	25.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**
The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER III								
S.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAC301	PC	Production of Agricultural crops	3	3	0	0	3
2	U18PCAC302	PC	Agricultural Botany	2	2	0	0	2
3	U18PCAC303	PC	Plant Biochemistry	2	2	0	0	2
4	U18PCAC304	PC	Agricultural Microbiology	3	3	0	0	3
5	U18PCAC305	PC	Principles Plant Breeding	3	2	1	0	3
6	U18BSMA301	BS	Transforms and Partial Differential Equations	4	3	1	0	4
PRACTICAL								
7	U18PCAC3L1	PC	Plant Biochemistry Lab	2	0	0	2	1
8	U18PCAC3L2	PC	Cell Biology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0

Total	25	15	2	8	19

SEMESTER IV								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAC401	PC	Plant Molecular Biology	3	3	0	0	3
2	U18PCAC402	PC	Crop Physiology	3	2	1	0	3
3	U18PCAC403	PC	Enzymology	2	2	0	0	2
4	U18PCAC404	PC	Process engineering in Biotechnology	3	2	1	0	3
5	U18PCAC405	PC	Production of horticultural crops	2	2	0	0	2
6	U18PCAC406	PC	Plant Cell and Tissue culture	3	3	0	0	3
7	U18PCAC407	PC	Plant pathology and disease management	3	3	0	0	3
8	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
9	U18PCAC4L1	PC	Agricultural microbiology Lab	2	0	0	2	1
10	U18PCAC4L2	PC	Process engineering Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	29	19	2	8	21

SEMESTER V								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA502	BS	Applied Agricultural Statistics	4	2	1	0	3
2	U18HSBA501	HS	Organizational behaviour	3	3	0	0	3
3	U18PCAC501	PC	Plant Genetic Engineering	3	2	1	0	3
4	U18PCAC502	PC	Entomology and Pest Management	3	2	1	0	3
5		PE	Professional Elective -I	3	3	0	0	3
6		PE	Professional Elective -II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
8	U18PCAC5L1	PC	Plant molecular biology and genetic engineering Lab	2	0	0	2	1
9	U18PCAC5L2	PC	Plant Cell and Tissue culture Lab	2	0	0	2	1

11	U18EEAC5C1	EE	Comprehension - I	0	0	0	0	1
ACTIVITY BASED COURSES								
12	U18MCAB509	MC	Self Development-Spiritual, Mindfulness & Meditation	2	0	0	2	0
13	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	29	18	3	8	21

SEMESTER VI								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAC601	PC	Fermentation Technology	2	2	0	0	2
2	U18PCAC602	PC	Biofertilizers and Biopesticides	3	2	1	0	3
3	U18HSBT601	HS	Bioentrepreneurship Development	3	3	0	0	3
4	U18PCAC603	PC	Fundamentals of Soil Science	3	2	1	0	3
5		PE	Professional Elective -III	3	3	0	0	3
6		OE	Open elective I	3	3	0	0	3
7	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
8	U18PCAC6L1	PC	Fermentation Technology Lab	2	0	0	2	1
9	U18PCAC6L2	PC	Biofertilizers and Biopesticides Lab	2	0	0	2	1
	U18PCAC6L3	PC	Crop Production Lab I- Agricultural crops	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB609	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB610	MC	Social Services – NSS	2	0	0	2	0
			Total	29	17	2	10	20

SEMESTER VII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCAC701	PC	Biotechnology of biotic and abiotic stress tolerance	3	3	0	0	3
2	U18PCBT702	PC	Research methodology and instrumentation	2	2	0	0	2
3	U18PCAC702	PC	Food Biotechnology	3	3	0	0	3
4		PE	Professional elective IV	3	3	0	0	3
		PE	Professional Elective V	3	3	0	0	3

5		OE	Open elective II	3	3	0	0	3
PRACTICAL								
6	U18PCAC7L1	PC	Food biotechnology Lab	2	0	0	2	1
7	U18PCAC7L2	PC	Crop Production Lab II- Horticultural crops	2	0	0	2	1
8	U18EEAC7P1	EE	Project I	6	0	0	6	3
9	U18EEAC7L3	EE	Internship (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	31	17	0	14	23

SEMESTER VIII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional elective VI	3	3	0	0	3
2		OE	Open Elective III	3	3	0	0	3
3		OE	Open elective IV (MOOC)	2	2	0	0	2
PRACTICAL								
5	U18EEAC8C2	EE	Comprehension – II	0	0	0	0	1
6	U18EEAC8P2	EE	Project II	18	0	0	18	9
ACTIVITY BASED COURSES								
7	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	28	8	0	20	18

TOTAL CREDITS: 168

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE I						
COURSE CODE	**SPECIALIZATION**	**COURSE NAME**	**L**	**T**	**P**	**C**
U18PEAC011	Crop production	Fundamentals of Agronomy	3	0	0	3
U18PEAC012	Farming systems	Farming System & Sustainable Agriculture	3	0	0	3
U18PEAC013	Food Science	Principles of food science and nutrition	3	0	0	3
PROFESSIONAL ELECTIVE II						
U18PEAC021	Crop production	Principles of Seed Technology	3	0	0	3
U18PEAC022	Farming systems	Post-Harvest and Food Engineering	3	0	0	3

U18PEAC023	Food Science	Dairy Process Technology	3	0	0	3
PROFESSIONAL ELECTIVE III						
U18PEAC031	Crop production	Introductory Agro-meteorology & Climate Change	3	0	0	3
U18PEAC032	Farming systems	Principles of organic farming	3	0	0	3
U18PEAC033	Food Science	Nutraceutical and functional foods	3	0	0	3
PROFESSIONAL ELECTIVE IV						
U18PEAC041	Crop production	Crop Improvement	3	0	0	3
U18PEAC042	Farming systems	Farm Management, Production & Resource Economics	3	0	0	3
U18PEBT031	Food Science	Food Process Technology	3	0	0	3
PROFESSIONAL ELECTIVE V						
U18PEAC051	Crop production	Bioremediation Technology	3	0	0	3
U18PEAC052	Farming systems	Greenhouse Technology	3	0	0	3
U18PEBT041	Food Science	Food safety and Quality control	3	0	0	3
PROFESSIONAL ELECTIVE VI						
U18PEAC061	Crop production	Soilless crop production	3	0	0	3
U18PEAC062	Farming systems	Nanotechnology in Agriculture	3	0	0	3
U18PEAC063	Food Science	Food industry waste management	3	0	0	3
OPEN ELECTIVE OFFERED BY DEPARTMENT OF BIOTECHNOLOGY SPECIALIZATION IN AGRICULTURAL BIOTECHNOLOGY						
U18OEAC001	Geo-informatics and Precision Farming		3	0	0	3
U18OEAC002	Livestock and Poultry Management		3	0	0	3
U18OEAC003	Extension methodologies and transfer of Agricultural Technologies		3	0	0	3
U18OEAC004	Soil and Water Conservation Engineering		3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMESALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion

41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001- Geo-informatics and Precision Farming
64. U18OEAC002- Livestock and Poultry Management
65. U18OEAC003- Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004- Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS004-Mobile Application Development
72. U18OECS005-System Modelling and Simulation
73. U18OECS006-Web Programming
74. U18OECS007-Virtual Reality
75. U18OECS008- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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LIST OF COURSES CATEGORYWISE

LIST OF HUMANITIES INCLUDING AND SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	3	2	1	0	3
3	U18HSBA502	HS	Organizational behaviour	3	3	0	0	3
4	U18HSBT601	HS	Bio entrepreneurship Development	3	3	0	0	3
TOTAL CREDITS								**12**

LIST OF BASIC SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	3	1	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
5	U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
6	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	3	1	0	4
7	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
8	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
9	U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
10	U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
11	U18BSMA301	BS	Transforms and Partial Differential Equations	4	3	1	0	4
12	U18BSMA502	BS	Applied Agricultural Statistics	4	3	0	0	3
TOTAL CREDITS								**30**

LIST OF ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18ESCS1L1	ES	Problem Solving and Python ProgrammingLab	3	0	0	3	1.5
4	U18ESGE201	ES	Cytology and Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
7	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
TOTAL CREDITS								**17**

LIST OF PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18PCAC301	PC	Production of Agricultural crops	2	2	0	0	2
2	U18PCAC302	PC	Agricultural Botany	3	2	1	0	3
3	U18PCAC303	PC	Plant Biochemistry	3	3	0	0	3
4	U18PCAC304	PC	Agricultural Microbiology	3	3	0	0	3
5	U18PCAC305	PC	Principles Plant Breeding	2	2	0	0	2
6	U18PCAC3L1	PC	Plant Biochemistry Lab	2	0	0	2	1
7	U18PCAC3L2	PC	Cell Biology Lab	2	0	0	2	1
8	U18PCAC401	PC	Plant Molecular Biology	3	3	0	0	3
9	U18PCAC402	PC	Crop Physiology	3	2	1	0	3
10	U18PCAC403	PC	Enzymology	3	2	1	0	3
11	U18PCAC404	PC	Process engineering in Biotechnology	2	2	0	0	2
12	U18PCAC405	PC	Production of horticultural crops	2	2	0	0	2
13	U18PCAC406	PC	Plant Cell and Tissue culture	3	3	0	0	3

14	U18PCAC407	PC	Plant pathology and disease management	3	3	0	0	3
15	U18PCAC4L1	PC	Agricultural microbiology Lab	2	0	0	2	1
16	U18PCAC4L2	PC	Process engineering Lab	2	0	0	2	1
17	U18PCAC501	PC	Plant Genetic Engineering	3	2	1	0	3
18	U18PCAC502	PC	Entomology and Pest Management	3	2	1	0	3
19	U18PCAC5L1	PC	Plant molecular biology and genetic engineering Lab	2	0	0	2	1
20	U18PCAC5L2	PC	Plant Cell and Tissue culture Lab	2	0	0	2	1
21	U18PCAC601	PC	Fermentation Technology	2	2	0	0	2
22	U18PCAC602	PC	Biofertilizers and Biopesticides	3	2	1	0	3
23	U18PCAC603	PC	Fundamentals of Soil Science	3	2	1	0	3
24	U18PCAC6L1	PC	Fermentation Technology Lab	2	0	0	2	1
25	U18PCAC6L2	PC	Biofertilizers and Biopesticides Lab	2	0	0	2	1
26	U18PCAC6L3	PC	Crop Production Lab I- Agricultural crops	2	0	0	2	1
27	U18PCAC701	PC	Biotechnology of biotic and abiotic stress tolerance	3	3	0	0	3
28	UI8PCBT702	PC	Research methodology and Instrumentation	2	2	0	0	2
27	U18PCAC702	PC	Food Biotechnology	3	3	0	0	3
29	U18PCAC7L1	PC	Food biotechnology Lab	2	0	0	2	1
30	U18PCAC7L2	PC	Crop Production Lab II- Horticultural crops	2	0	0	2	1
TOTAL CREDITS								**65**

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18EEAC5C1	EE	Comprehension - I	0	0	0	0	1
2	U18EEAC7P1	EE	Project I	6	0	0	6	3

3	U18EEAC7I1	EE	Internship (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
4	U18EEAC8C2	EE	Comprehension – II	0	0	0	0	1
5	U18EEAC8P2	EE	Project II	18	0	0	18	9
TOTAL CREDITS								**15**

LIST OF MANDATORY COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
2	18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	U18MCAB203	MC	Yoga	2	0	0	2	0
4	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
8	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
9	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
10	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development- religion and Inter-faith	2	0	0	2	0
13	U18MCTH603	MC	Essence of Indian knowledge Tradition	2	2	0	0	0
14	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
15	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
16	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0

17	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
18	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL CONTACT PERIODS				**36**				

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	**Humanities & Social Sciences (HS)**	3	3			3	3			12	**7.14**
2	**Basic Sciences (BS)**	10	13	4		3				30	**17.86**
3	**Engineering Sciences (ES)**	7.5	9.5							17	**10.12**
4	**Professional Core (PC)**			15	21	8	11	10		65	**38.69**
5	**Professional Electives (PE)**					6	3	6	3	18	**10.71**
6	**Open Electives (OE)**						3	3	5	11	**6.55**
7	**Employability Enhancement (EE) Courses - Project Work, Seminar, Internship, Term Paper, etc.**					1		4	10	15	**8.93**
	Total Credit	20.5	25.5	19	21	21	20	23	18	168	**100**
	Total Contact Hour	**35**	**36**	**25**	**29**	**29**	**29**	**31**	**28**	**242**	

SEMESTER I

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Coordinator & Dept Designed by: ……Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6 hours

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing one self – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6 hours

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6 hours

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6hours

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6hours

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures-

Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely.

SOFTSKILL LABORATORY
LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews &conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds- intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001
8. Web link:

COURSE OUTCOMES		**Revised Bloom's Taxonomy Level**
CO1	The student will be able to comprehend the text with clarity	
CO2	The capacity to read and listen will improve	
CO3	Writing technical report will be learnt properly	
CO4	Speaking skills will be acquired	
CO5	Overall communication skills will make them employable	
CO6		

MAPPING BETWEEN COURSE OUTCOMES&PROGRAM OUTCOMES														
COs\POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
1				**M**			**H**		**M**					
2				**M**			**H**		**M**					
3				**M**			**H**		**M**			**H**		
4				**M**			**H**		**M**			**M**		
5				**M**			**H**		**M**			**H**		
6														
Category	Humanities and Social Studies (HS)													
Approval	47th Meeting of Academic Council held in Aug 2018													

U18BSMA102	**MATHEMATICS I FOR BIO ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	➢ The aim is to develop mathematical curiosity and use inductive and deductive reasoning when solving problems. ➢ Develop the knowledge, skills and attitudes necessary to pursue further studies in Mathematics and to become confident in using Mathematics to analyze and solve problems in real – life situations.				

UNIT I THEORY OF EQUATIONS (9+3)

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3) Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton

Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., Manickavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

COURSE OUTCOMES (COs)	
CO1	Solve the equations (such as linear, factorable, quadratic and rational), applications and linear inequalities, to know the formation of equations.
CO2	Use both the limit definition and rules of differentiation to differentiate functions.The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions
CO4	Compute definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gamma
CO5	Identify Eigen value problems from practical areas using transformations;

CO/PO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			W	M							
CO2	S				M		W			W		
CO3	S				M				W			W
CO4	S		S	W	M			M				
CO5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U 18BSPH101	**WAVES AND OPTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights

CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing												
CO3	Understand the propagation of light and geometrical optics												
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves												
CO5	Understand the concept of laser and its applications												
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	M			M	S	S		S
	CO2	W	S	M	M	S			M		W	S	
	CO3	S	W			W			M	M		M	M
	CO4	S	W			W			M	M		M	
	CO5	S	M	M	M				M		S	W	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. Nanocomposites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.

CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			M		S		S		W		
CO2		W	S		M		S		M		W	
CO3		M		S		W				M		M
CO4	S		M	W			M			S		
CO5		S		W		M				S		S
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Maths				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and

methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr,–An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd. 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)													
CO1	Develop algorithmic solutions to simple computational problems												
CO2	Demonstrate programs using simple Python statements and expressions.												
CO3	To gain knowledge regarding control flow and functions associated with python												
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound												
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems												
Mapping of Course Outcomes with Programme Outcomes (POs) (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	S	M	S	M	W		M	W	M	S
	CO2	S	S	M	M		M		W			M	
	CO3	M	M	W	S	M		W		W		M	M
	CO4	M	M	W	M	S	M	W	M	W		M	
	CO5	M	S	W	M	M			M	M	W		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	ENGINEERING GRAPHICS & DESIGN (THEORY & LAB.)	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypocycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)
Principles of Orthographic Projections; Conventions; Projections of Points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)
Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE 4:SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)
Sectional view of Prism, Cylinder, Pyramid, Cone (simple Position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students willgetExposure to basics of building construction
CO4	Students willgetExposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S			M			S					
	CO2	S	S	W		S	M						S
	CO3			S									
	CO4											S	M
	CO5	S						W					
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS1L1	PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Problem Solving and Python Programming				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	S	M	M	M	M		M	
	CO2	S	S	W	S	S	M	W	M	M	M	M	M

	CO3	S	S	M	M	M	M		M	M	M	M	
	CO4	S	M	S	S	S	M	M	M	M	W		
	CO5	S	S	M	S	M	M		M	M	W	M	S
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSPH2L3	**WAVE OPTICS AND BIO PHYSICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Wave Optics and Bio Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Biophysics – Bio-Engineering branches

1. Determination of optical rotation using polarimeter
2. Determination of diffusion potential of biological sample
3. Analysis of viscosity of different biological sample using viscometer
4. Analysis of protein concentration using calorimeter
5. Quantification of DNA using UV-Vis spectrophotometer
6. Analysis of absorption maxima for an unknown sample

Course Outcome (CO's)	
CO1	Understand the fundamental concept of optics
CO2	Understand the concept of production of ultrasonic waves
CO3	Understand the estimation and functions of Biomolecules

Mapping of Course Outcomes with Programme Outcomes (POs)
S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S		S	S				S	W	M		S
	CO2	S	S	W					S	W	M		
	CO3				S				S	M	W		M
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH2L4	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a Polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COs WITH POs: S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S		M	M		S		S		W		
CO2	W	S			M		S		M		W	S
CO3		M		M						M		

CO4	S		M				M				S	M
CO5		S		W		M				S		
Category	Basic Sciences (BS)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				
OBJECTIVES To gain fundamental knowledge of English language and its usage in day to day life.					

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports - Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology.OrientBlackswan, Hyderabad: 2016

2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

Upon completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	a	B	c	d	e	f	g	h	i	j	k	l
1	M										S	
2		S							M			
3			S							S		S
4				M		S						
5					M		M	W				

Category	Basic Science (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

	MATHEMATICS II FOR BIO ENGINEERING	**L**	**T**	**P**	**C**
U18BSMA202	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	➢ To make the students learn Mathematics in order to formulate. ➢ To Solve problems effectively in their respective fields of engineering				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Integration of vector function - Green's theorem in a plane – Gauss divergence theorem and Stoke's theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions,Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO3	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO4	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO	M		W		S				M		S	
CO	S	M			S				W			
CO	S	M			S			M		W		S
CO	S		W				M		S			

CO	S		W	W			M				S	
Cat	Basic Science (BS)											
App	47th Meeting of the Academic Council Meeting held in Aug, 2018											

U18BSPH203	**INTRODUCTION TO BIOPHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart theories and methods of Physics to understand the functioning of Biological system					

UNIT 1 ATOMIC PHYSICS **9**

Atom model - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - spatial quantisation - Bohr magneton - Stern and Gerlach experiment.

UNIT 2 NUCLEAR PHYSICS **9**

Nuclear size, shapes and forces: Nuclear size determination - Electron scattering method-electric moments - magnetic moments - Nuclear forces - Models of nuclei – Liquid drop model of nuclei- Atomic masses and its significance.

UNIT 3 RADIATION BIOPHYSICS **9**

Basics of Radiation Physics Atomic structure models, Constituents of atomic nuclei, Isotopes, Isobars, Isotones, Radioactivity, law of Radioactivity, General properties of alpha, beta and gamma radiations, Radiation units: Units of measurement of radioactivity. Curie, Becquerel., Interaction of radiation with matter: Excitation and ionization, Photo electric effect, Compton Effect, pair production, Characteristic radiation.

UNIT 4 MEMBRANE BIOPHYSICS **9**

Membrane potentials Cell surface charge, Resting membrane potential, Action potential, Ionic transport during Action Potential, properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, total electrochemical potential.

UNIT 5 MOLECULAR BIOPHYSICS **9**

Nucleic acids – Purine and Pyrimidine bases, nucleosides, nucleotides basic difference in structures and functions of DNA and RNA

Proteins– Amino acids – types, planarity of peptide bond – Ramachandran map - Primary, secondary, tertiary and quarternary structures of proteins.

REFERENCE BOOKS:

1. R.Murugeshan and KrithigaSivaprasath, "Modern Physics", S.Chand publisher, 2016 (for Unit 1& 2)
2. Brij and Subramanian, "Atomic and Nuclear Physics" ,S.Chand publisher, 2008 (for Unit 1 & 2)
3. JB Rajam, "Atomic Physics", 7th Edition, S.Chand publisher, 2005 (for Unit 1)
4. M.Volkenstein "General Biophysics" 1st Edition, Academic press, 1983 (for Unit 4)

5. Voet and Voet, "Introduction to Biochemistry" , 5th Edition, John Wiley & sons Inc., 2016 (for Unit 5)
6. Branden and Tooze, "Introduction to Protein Structure"2nd edition, Garland publishing, 1999
7. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014

Course Outcome (COs)	
CO1	Understand the fundamental concept of Atomic Physics
CO2	Understand the basic concept of Nuclear Physics
CO3	Understand the Radiation Physics and its measurement
CO4	Understand the Membrane Biophysics with functions of different potentials
CO5	Understand the Structural and molecular Biophysics

Mapping of Course Outcomes with Programme Outcomes,
S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	W	W	W					S	W	M		
	CO2	W	W	W					S	W	M		S
	CO3	W	W	W					S	W	M		
	CO4	W	W	W					S	W	M		M
	CO5				M				S	W	W		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSGE201	**CYTOLOGY AND GENETICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES: To provide a basic understanding of cell, its structure, function, types and about its culture					

UNIT I CELL STRUCTURE AND ORGANELLES 6

Cells - definition - eukaryotic cell and prokaryotic cell- Relationship and evolution of eukaryotic cell and prokaryotic cell- plant cells and animal cells - Cell Organelles, Structure and function – Nucleus- Endoplasmic reticulum - Golgi complex- lysosomes- cell membranes- chloroplast- mitochondria.Cell cycle-Mitosis and meiosis

UNIT II CELLULAR TRANSPORT 6

Transport across cell membranes – classification – Active and passive transport. Active – Na+ K+ ATPase Pump - Lysosomal and Vacuolar pumps - Endocytosis and Exocytosis transport across prokaryotic membrane - Cotransport – Symport, antiport.

UNIT III CELL SIGNALING AND SIGNAL TRANSDUCTION 6

Cell signaling – various kinds of Receptors and ligands –Different modes of action of ligands- different modes of signal transduction and amplification with examples- signaling through G-

Proteins (Monomeric and trimeric), signaling for growth factors- secondary messengers- protein kinases- Ca ions and cAMP molecule in signaling.

UNIT IV BASICS OF GENETICS AND CHROMOSOMES 6

Mendelian Laws - Mendel's experiment - monohybrid cross-phenotype – genotype - Dihybrid inheritance - Chromosome structure and organization in prokaryotes and eukaryotes - chromosome banding - chromosome abnormalities

UNIT V ALLELES 6

Classical concepts of Pleomorphism - Multiple alleles, ABO blood groups - Rh factor - sex linkage in Drosophila- mechanism of sex determination- sex differentiation

TEXT BOOKS:

1. The Cell, Geoffrey M. Cooper & Robert E. Housman, Sinauer Associates Inc, 2015.
2. Genetics, Monroe W. Strickberger, Pearson Education India, 2015.

REFERENCE BOOKS:

1. Molecular Biology of the Cell, John Wilson and Tim Hunt, Garland science, 2014.
2. Cell Biology and Histology, Leslie P.Gartner and James L.Hiatt, Wolters Kluwer, 2014.
3. Principles of Genetics, Eldon John Gardener et al., Wiley publications, 2006.

COURSE OUTCOMES (COs)													
CO1	To understand the fundamentals of the structure of cells												
CO2	To study the types and functions of cell organelles												
CO3	To comprehend the methods involved in the cellular transport												
CO4	To know the cause, and methods of cell signaling												
CO5	To give a basic knowledge of cell culture and its applications												
CO6	To understand about signal transduction												
Mapping of Course Outcomes with Program outcomes (POs) S-Strong, M-Medium, W-Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S					M	M	S				
	CO2	S			M			M		M			M
	CO3	M	M								M		
	CO4	S		M				S				M	S
	CO5	S					M					S	
	CO6	S			S				S		M		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2011.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition, 2015.
6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, Mcgraw Higher Ed, 1st Edition, 2011.

3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)													
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.												
CO2	To gain knowledge regarding fundamentals of AC circuits.												
CO3	To gain knowledge regarding electrical machines and transformers.												
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.												
CO5	To gain knowledge on principles of digital electronics systems.												
Mapping of Course Outcomes with Programme Outcomes (POs) (S/M/W indicates strength of correlation) S-Strong, M-Medium, W- Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	W			M				S		W	
	CO2	S	W			M				S		W	W
	CO3	S	M			M				S		W	
	CO4	S	W			M				S		W	M
	CO5	S	W			M				S		W	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.
Human population: Population growth, variation among nations, population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.

2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	S			M		S		S		W		
CO2	W	S	S		M		S		M		W	M
CO3		M				W			S	M		
CO4	S		M	W			M				M	W
CO5		S		W		M				S		

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESME1L2	**WORKSHOP/MANUFACTURING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS
Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**

- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

1. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

2. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

3. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.

CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											S	
	CO2			S	M							S	
	CO3		M										S
	CO4	S			W							S	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS

5. Applications of Operational Amplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson Education India,2011

COURSE OUTCOMES (COs)													
CO1	To handle basic electrical equipments and verify current and voltage law												
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .												
CO3	To understand domestic wiring procedures practically.												
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator												
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor												
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flops												
Mappingof Course Outcomes (COs) with Programme Outcomes (POs) (S/M/W indicates strength of correlation) S- Strong, M-Medium, W- Weak													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S			S				S		M	
	CO2	S	S			S				S		M	W
	CO3	S	S			S				S		M	
	CO4	S	S			S				S		M	M
	CO5	S	S			S				S		M	
	CO6	S	S			S				S		M	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

SEMESTER III

U18PCAC301	**PRODUCTION OF AGRICULTURAL CROPS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Biology				
	Course Designed by – Dept. of Industrial Biotechnology				
	Course Coordinator-				

OBJECTIVES To give a basic knowledge of agricultural crops and its production	
COURSE OUTCOMES (COs)	
CO1	to understand the various types of cereals
CO2	to know the production practice in millets
CO3	to know the production practice in pulses
CO4	to know the production practice in oilseeds (Kharif)
CO5	to know the production practice in oilseeds (rabi)

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
	CO6												
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)	
							√						
4	Approval	Academic Council, July 2018											

UNIT I CEREALS 9

Rice, Maize, Wheat, Oat, Barley, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield

UNIT II MILLETS 9

Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield

UNIT III PULSES 9

Redgram, Blackgram, Greengram, Bengalgram, Horsegram, Cowpea, Soybean and Lentil - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield

UNIT IV OILSEEDS (KHARIF) 9

Groundnut, sesame, sunflower, castor, Origin, and geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

UNIT V OILSEEDS (RABI) 9

Rape seed and mustard, safflower, Linseed, Niger - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield

TEXT BOOK:

1. Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut.

REFERENCE BOOKS

1. Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co Pvt. Ltd, New Delhi.
2. Singh. S.S. 1997, Crop management under irrigated and rainfed conditions, Kalyani Publishers, New Delhi

U18PCAC302	AGRICULTURAL BOTANY	L	T	P	C
	Total Contact Hours - 45	2	0	0	2
	Prerequisite – Biology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES
To provide a basic knowledge of crops and its botany

COURSE OUTCOMES (COs)

CO1	to understand the classification of plants
CO2	to know the importance of poaceae
CO3	to know the importance of papillonaceae
CO4	to know the importance of oilseeds and vegetable crops
CO5	to know the importance of fibre crops

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		a	b	c	d	e	f	g	h	i	j	k	l
1	COs/POs												
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H								
	CO3	H				H		M					M
	CO4	H	M		H	H							
	CO5	H	M	M		H		M					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNITI INTRODUCTION 9

Bentham and Hooker's classification of plant kingdom — International code of nomenclature and its major guidelines – author citation – Agricultural classification of crops; General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape,

venation and phyllotaxy; Modification of roots and leaf; Floral morphology: Kinds of bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.

UNIT II ECONOMIC USES OF POEACEAE 9

List of cultivated crops, economic parts, chromosome number and family description of Poaceae: Key botanical features of Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, list of small millets, Guinea grass, Napier grass, and Sugarcane

UNIT III ECONOMIC USES OF PAPILIONACEAE 9

List of cultivated crops, economic parts, chromosome number and family description of Papilionaceae: Key botanical features of Red gram, Soybean, Black gram, Green gram, Cowpea, Lablab, and Groundnut.

UNIT IV ECONOMIC USES OF OTHER PLANTS 9

List of cultivated crops, economic parts, chromosome number and family description of the following families and Key botanical features of the crops given against them: Pedaliaceae - Gingelly; Asteraceae- Sunflower, Safflower, Euphorbiaceae: Castor; Jatropha and Tapioca; Arecaceae: Coconut; Solanaceae: Tobacco, Potato, Chilli

UNITVECONOMIC USES OF FIBRE CROPS 9

List of cultivated crops, economic parts, chromosome number and family description of the following families and key botanical features of the crops given against them ,Malvaceae: Cotton, Mesta and Bhendi.

TEXT BOOK

1. Daniel Sundararaj, D. and G. Thulasidas, 1993. Botany of field crops. MacMillan India Ltd., New Delhi.
2. Sambamurthy, V.S. and N.S. Subramanian, 1989. Text Book of Economic Botany, Wiley Eastern, New Delhi

REFERENCE BOOKS

1.Purse glow, 1988. Tropical Crops – Monocotyledons, The English Language book Society and Longman Co., Singapore
2. Purse glow. 1988. Tropical Crops - Dicotyledons. The English language book Society and Longman Co., Singapore.
3. Albert F. Hill and O.P. Sharma, 1996. Economic Botany. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
4. John Joel, A., C. Vanniarajan, T.S. Raveendran, and A. Gopalan 2006. Fundamentals of Crop Botany, Directorate of ODL, Tamil Nadu Agricultural University, Coimbatore–641 003

	PLANT BIOCHEMISTRY	L	T	P	C
U18PCAC303	Total Contact Hours - 45	2	0	0	2
	Prerequisite – Basic Chemistry and Biology				

	Course Designed by – Dept. of Agricultural Biotechnology

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of biomolecules, their classification, structure
CO2	to apply the basic concept of carbohydrates, proteins ,lipids, nucleicacids and enzymes in metabolism.
CO3	to know the application of biomolecules in functioning of biological system
CO4	to get a basic knowledge of macromolecules in living organism and its energetic
CO5	To know basic concepts of enzymes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M				H						L
	CO2								H			H	
	CO3	H		H		H				H	H		H
	CO4	H	M				H	H					
	CO5	H										H	

3	Category	Humanities & Social Studies (HS)	Basic Sciences	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I CARBOHYDRATES 9

Introduction- Carbohydrates: classification and functions of carbohydrates- structure of monosaccharides: Glucose, Fructose, Oligosaccharides: Sucrose, Lactose, Polysaccharides: Starch, Cellulose-Metabolism- Glycolysis, TCA.

UNIT II LIPIDS 9

Lipids: classification- Structure and function of Simple lipid: Fats and waxes, Complex lipid: Phospholipids -Biosynthesis and β oxidation of fatty acid

UNIT III AMINO ACIDS AND PROTEINS 9

Aminoacids: Structure and classification- proteins: structures – properties – classification based on structure, function and nature. Biosynthesis of aromatic amino acid and Urea cycle

UNIT IV NUCLEIC ACIDS 9

Nucleosides- Nucleotides – Secondary structure of DNA –structure of mRNA, tRNA and rRNA- Biosynthesis and degradation of purines and pyrimidines

UNIT V ENZYMES **9**

Classification of enzymes- active site -Factors affecting enzyme activity- Enzyme specificity- Mechanism of enzyme action- Enzyme kinetics related to Michaelis-Menten equation.

Text Book

1. Lehninger Nelson &Cox ,2005 "Principles of Biochemistry",4th Ed
2. J.L. Jain, 2008, "Fundamentals of biochemistry" S. Chand.8th Ed

Reference Books

3. Zubey 2004 "Biochemistry" III Ed,
4. Voet&Voet 2006, "Biochemistry" V ed,.

Weblink: nptel

U18PCAC304	AGRICULTURAL MICROBIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic concepts in biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of microbes and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the source of microbes and their role in biotechnology
CO2	to get the knowledge of microbial diversity classification and morphology
CO3	to know the visualization of microbes by different microscopes
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens
CO5	to get a basic knowledge of the microbial nutrition and growth

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M			H	H	H	H		H
	CO2	H		M									
	CO3	H						H		H			H
	CO4	H		M	M			H					
	CO5	H				H	H						

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I INTRODUCTION TO MICROBIOLOGY 9

Definition-Scope and history of microbiology-prokaryotic and eukaryotic cell- different types of classification-Nomenclature-fermentation-pasteurization-role of microorganisms in agro industries-illustrations of genetically engineered strains

UNIT II GENERAL FEATURES OF MICROORGANISMS 9

Bacteria: diversity-classification-morphology-life cycle-Fungi: diversity-classification-morphology-life cycle-Algae: diversity-classification-morphology-life cycle-virus: diversity-classification-morphology-life cycle

UNIT III MICROSCOPY 9

Introduction- numerical aperture, resolving power-magnification- fixation, dyes and simple staining, differential staining- gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining-simple-compound-dark field-phase contrast-polarizing-fluorescent-laser optics-electron microscopy-scanning electron microscope-transmission electron microscope, specimen preparation-inverted microscope

UNIT IV MICROBIAL NUTRITION AND GROWTH 9

Common nutrient requirements-nutritional types of microorganisms, growth factors-uptake of nutrients by cells- culture media: synthetic or defined media-commonly used media-Types of media-selective-differential-enrichment media-aseptic techniques: disinfection-sterilization-cultivation of microbes: bacteria-fungi-viruses-pure culture: concept of pure culture-methods of pure culture of microorganisms–spread plate, streak plate and pour plate–microbial growth curve-factors affecting growth of microorganisms-measurement of growth

UNIT V MICROBIAL PATHOGENS AND DISEASES 9

Some bacterial diseases of agricultural crops -pathogens, symptoms and control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection – phenolics – phytoalexins and related compounds. Bioinsecticides – viral, bacterial and fungal- a brief note.

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg, 2005, “Microbiology “ TATA McGraw Hill, 5thed
2. Anantha Narayan, C.K. JayaramPaniker, 2009, “Text Book of Microbiology” Orient Blackswan, 7thed

REFERENCE BOOKS

1. Presscott and Dunn, 2006, "Industrial Microbiology" CBS Publishers& Distributors.
2. Daniel V.Lim, "Microbiology", Kendall Hunt, 2002 ed
3. Weblink: nptel

U18PCAC305	PRINCIPLES OF PLANT BREEDING	L	T	P	C
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Biochemistry, Microbiology, Environmental Studies				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about plant breeding

COURSE OUTCOMES (COs)

CO1	to understand the basic principles in breeding
CO2	to know about linkage and its importance
CO3	to study about population genetics
CO4	to know about gene structure
CO5	to get idea about mutation and its significance in breeding

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M	H	H		L	L	L	M
	CO2	H	M	M	H	H	H	M	H				M
	CO3	H	M		H		H	H			L	L	
	CO4	H	M		H	H	H	M			L		M
	CO5	H	M	M	H	H	H	M	M	M	L	L	

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I: INTRODUCTION **9**

Beginning of genetics; Cell structure and cell division; Early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance.-Multiple alleles,Gene interactions.

UNIT II: SEX DETERMINATION AND LINKAGE

Sex determination, Sex differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage- Coupling and repulsion detection, estimation; Recombination and genetic mapping in eukaryotes

UNIT III: POPULATION GENETICS 9

Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium-Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Genetic code

UNIT IV: GENE STRUCTURE 9

Genetic fine structure analysis, , Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters- Regulation of gene activity in prokaryotes; Bacterial plasmids, insertion (IS) and transposable (Tn) elements

UNIT V: MODERN CONCEPT OF GENETICS AND MUTATION 9

Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; - Concepts of Eugenics, Epigenetics, Genetic disorders and Behaviouralgenetics , types of mutation

TEXT BOOK

1.Gardner EJ &Snustad DP. 1991. Principles of Genetics. John Wiley & Sons
2.Klug WS & Cummings MR. 2003. Concepts of Genetics. Peterson Edu
3.Lewin B. 2008. Genes IX. Jones & Bartlett Publ
4.Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co

REFERENCE BOOKS

1.Snustad DP & Simmons MJ. 2006. Genetics. 4th Ed. John Wiley & Sons
2.Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India
3.Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Pub

U18BSMA301	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by – Department of Mathematics				
OBJECTIVES Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.Learn techniques of solving the standard types of first order and second order partial differential equations.Learn solving wave and heat equation using Fourier series.Understand the problems using Fourier transform and their properties. Understand the problems using Z - transform and their properties.					
COURSE OUTCOMES (COs)					

CO1	to expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data
CO2	to solve PDE and higher order with constant coefficients and physically interpret the results
CO3	to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations
CO4	to solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications
CO5	to apply the basics of Z – Transform in its applicability to discretely varying functions, gained the skill of formulate certain problems in terms of difference equations and solve them using the Z – Transform techniques

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S		M	M						W	
	CO2	S		W		S		M	M				W
	CO3	S			S	M			M		W		
	CO4	S			M					W			
	CO5	S					M						W

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I FOURIER SERIES (9+3)Hrs Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS (9+3)Hrs Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3)Hrs

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORMS (9+3)Hrs Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORMS AND DIFFERENCE EQUATIONS (9+3)Hrs

Z – Transform – Elementary properties – Inverse Z – Transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – Transform.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
3. Venkataraman. M. K. "Engineering Mathematics Volume III" , 13th Edition National Publishing Company, Chennai, 1998.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.
5. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.

U18PCAC3L1	PLANT BIOCHEMISTRY LAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Basic concepts in chemistry and biology				
	Course Designed by – Dept. of Agricultural Biotechnology				

OBJECTIVES

To provide a basic knowledge of biochemical components and its functions and their Applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of biomolecules, their classification,structure and functions
CO2	to apply the basic concept of carbohydrates, proteins,lipids, nucleicacids and enzymes in metabolism
CO3	to know the application of biomolecules in functioning of biological system
CO4	to get a basic knowledge of macromolecules in living organism and its energetics
CO5	To know basic concepts of enzymes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	H	H			H			H	H	
	CO2	H	H	H	H			H			H	H	
	CO3	H	H	H	H			H			H	H	
	CO4	H	H	H	H			H			H	H	
	CO5	H		H				H			H	H	
3	Category	Humanities	Basic Engg.	Professional Core	Non Open						Project		
					√								
4	Approval	Academic Council, July 2018											

LIST OF EXPERIMENTS

1. Preparation of normal, molar and percent solutions.
2. Preparation of different buffer solution and measure pH.
3. Qualitative analysis of Unknown sugar- Monosaccharides,disaccharides and polysaccharides.
4. Estimation of sugar- Benedicts method.
5. Qualitative of unknown protein- Albumin,casein and gelatin.
6. Quantitative test for aminoacids- Ninhydrin method.
7. Quantitative test for protein – Biuret method.
8. Quantitative test for protein –Lowry method.
9. Quantitative test for protein – Bradford method
10. Spectrophotometric analysis of DNA.

U18PCAC3L2	CELL BIOLOGYLAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – basic cell biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide a basic knowledge about cell biology

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of instruments and their different mode of applications
CO2	to get idea about slide preparation
CO3	to know about blood grouping
CO4	to get knowledge about mitosis
CO5	to get a basic knowledge of extraction of plant pigments

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											H	

	CO2	H						H					
	CO3	H	H										
	CO4									L			
	CO5						L						L
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)		Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)
							√						
4	Approval	Academic Council, July 2018											

LIST OF EXPERIMENTS

1. Study of Microscope
2. Spotters
3. Permanent Slide preparation
4. Killing and Fixing
5. Mitosis on onion root tip
6. Cryopreservation
7. Preparation of Blood smear
8. Separation of plasma and serum from blood sample
9. Total RBC and WBC Count
10. Osmosis
11. Extraction of pigments

U18MCAB305 Learning an Art Form 0 0 2 0

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306Intangible Cultural Heritage (Festivals, Food ways, Local Games) 0 0 2 0

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

To study and document the prevalent social practices and beliefs regarding traditional foods;

To study and document the feasts on religious and social occasions of different communities;

To identify and document the food items consumed by different communities and determine their nutritional values;

To conduct chemical analysis of food ingredients;

To identify and document the kitchen generated health ingredients used by different communities;

To find out the uses of leftover food stuff of different communities;

To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and

To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

SEMESTER IV

U18PCAC401	**PLANT MOLECULAR BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basics of Cell biology and biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of molecular level of DNA and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of central dogma of biological systems
CO2	to understand the concept of DNA replication
CO3	to learn the methods involved in transcription
CO4	to know the functioning of regulatory factors and its application in maintaining cell activity
CO5	To remember the method of protein synthesis
CO6	to analyze the role of nucleic acids in understanding the genetic code

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H		H					
	CO2	H							H		H	H	H
	CO3	H		H	H	H	H	H				M	

	CO4	H						M					
	CO5	H						H					
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
							√						
4	Approval	Academic Council, July 2018											

UNIT I DNA STRUCTURE 9

DNA as the vehicle of inheritance-structure of DNA-forms of DNA-nucleic acid biosynthesis-experimental evidence: Griffith, McLeod, McCarty and Avery, Hershey–Chase experiments-Definition of gene-organization of genes and non coding DNA in prokaryotes- Eukaryotes–mitochondrial and chloroplast genome-cytoplasmic male sterility-unique, moderately repetitive and highly repetitive DNA sequence-satellite DNA- Cot value-maize transposable elements-DNA binding proteins

UNIT II DNA REPLICATION 9

DNA replication in prokaryotes and eukaryotes- modes of replication-semi continuous and semi discontinuous replication- Okazaki fragments- RNA primers – enzymes of replication – DNA polymerases I, II, III, -DNA modifying enzymes: topoisomerases-helicases- binding proteins and ligases-events at OriC (initiation), events on the replication fork (elongation) and termination-Fidelity of replication

UNIT III DNA REPAIR 9

Repair of DNA–types of damages- repair by direct reversal of damage- excision repair-recombination repair- SOS repair-Mutation: definition-type of mutations (spontaneous and induced) point mutation-Gene mutation and chromosomal aberrations- Cause of mutations-chemical and physical agent

UNIT IV TRANSCRIPTION 9

Transcription in prokaryotes and eukaryotes: RNA polymerases–enzyme structure- role of sigma factor- promoter-closed and open promoter complexes-Initiation-elongation and termination of RNA synthesis-Post transcriptional modification in prokaryotes and eukaryotes-transcription factors

UNIT V GENETIC CODE 9

Genetic code–Basic features of genetic code-Deciphering of genetic code-Wobble hypothesis-Protein biosynthesis-activation of amino acids- initiation-elongation and termination of translation in prokaryotes and eukaryotes-Post translational modifications-Inhibitors of translation.-Regulation of gene expression in prokaryotes and eukaryotes- operon concept-lac operon

TEXT BOOKS

1. Biochemistry by Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2006

2. Lehninger, Principles of Biochemistry, David L. Nelson and Michael M. Cox, 2008
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann, Molecular Biology of the Gene (6th ed), 2007

REFERENCE BOOKS

1. R.L. Adams, J.T. Knowler, and D.P. Leader, The Biochemistry of the Nucleic Acids, 1992
2. Stephen Neidle, Principles of Nucleic Acid Structure, 2007
3. Robert Weaver, Molecular Biology, 2007
4. Weblink: nptel

U18PCAC402	**CROP PHYSIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Basic Chemistry and Biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To learn the physiological parameters of different crops

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of crop physiology
CO2	To remember the basic constituents of plant nutrition
CO3	to know the application of respiration and photosynthesis
CO4	to get a basic knowledge of factors contributing to the growth of plants
CO5	To remember the factors contributing to stress in plants
CO6	To analyze the relationship between stress factors and physiological changes in plants

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M				H						L
	CO2								H			H	
	CO3	H		H		H				H	H		H
	CO4	H	M				H	H					
	CO5	H										H	

3	Category	Humanities & Social Studies (HS)	Basic Sciences	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I PLANT WATER RELATIONS **9**

Importance of Crop Physiology in Agriculture .Structure and role of water –water potential and its components – diffusion – osmosis – imbibition - plasmolysis – Field Capacity and Permanent Wilting Point- Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast - Transpiration – significance – structure of stomatal pore- mechanisms of stomatal opening and closing – guttation – antitranspirants

UNIT II PLANT MINERAL NUTRITION **9**

Criteria of essentiality - classification of nutrients – macro, micro, mobile, beneficial elements and immobile – mechanism of nutrient uptake- Physiological functions, deficiencies and disorders of macro and micro nutrients – Hidden hunger- Foliar nutrition- root feeding and fertigation

UNIT III PHOTOSYNTHESIS AND RESPIRATION **9**

Light reaction – Photosystems- red drop and Emerson enhancement effect- Photolysis of water and photophosphorylation - Z scheme - Photosynthetic pathways – C_3 and C_4, CAM – difference between three pathways

UNIT IV GROWTH AND DEVELOPMENT **9**

Growth – phases of growth - Factors affecting growth – Hormones- classifications - Biosynthetic pathway and role of auxins - Biosynthetic pathway and role of gibberellins and cytokinins- Biosynthetic pathway and role of ethylene and ABA- Growth retardants- Photoperiodism - short, long and day neutral plants.

UNIT V STRESS PHYSIOLOGY **9**

Classification of stresses - Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation

Text Books

1. P. Boominathan, R. Sivakumar, A. Senthil, and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
2. Jain, V.K. 2007. Fundamentals of plant physiology, S.Chand& Company Ltd., New Delhi.
3. Taiz. L. and Zeiger. E., 2010 (Fifth edition). Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

e- books and e-references

·**http://www.plantphys.org**

http://www. Biologie. Uni-hamburg. de/b-online

U18PCAC403	ENZYMOLOGY	L	T	P	C

	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Basic Chemistry and Biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: to study about enzymes and its applications

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of enzymes
CO2	to apply the basic concept of enzyme catalysis
CO3	to know the application of enzyme kinetics
CO4	to get a basic knowledge of immobilization of enzyme
CO5	To understand basic concepts of bioreactors
CO6	To apply the enzyme chemistry concepts in industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M				H						L
	CO2								H			H	
	CO3	H		H		H				H	H		H
	CO4	H	M				H	H					
	CO5	H										H	

3	Category	Humanities & Social Studies (HS)	Basic Sciences	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNITI ENZYMES **9**

Classification of enzyme-Characteristics of enzymes, enzyme substrate complex- Concept of active centre, binding sites, stereo specificity and ES complex formation-Activation energy-Enzyme activity, specific activity, turnover number-Applications of enzymes in agricultural sectors

UNIT II ENZYME CATALYSIS **9**

Enzyme catalysis-Factors affecting catalytic efficiency - proximity and orientation effects, acid - base catalysis. Isoenzymes and multiple forms of enzymes-Allosteric enzymes, Allosteric

regulation- Brief account of coenzymes, multienzyme complexes, metal-dependent, metalloenzymes

UNIT III ENZYME KINETICS 9

Michaelis - Menten Equation - form and derivation- steady state enzyme kinetics-Significance of Vmax and Km, L-Burk plot, Eadie- Hofstee plot-Bisubstrate reactions-Enzyme inhibition- irreversible and reversible, competitive, noncompetitive

UNITIV MICROBIAL KINECTICS AND IMMOBILIZATION 9

Typical growth characteristics of microbial cells: Phase of growth curve, factors affecting growth- Monod Model - Effect of temperature, pH and substrate concentration on reaction rate. Immobilization of enzymes: methods of immobilization, applications and advantages.

UNITV BIOREACTORS 9

Classification- Stirred tank reactor, Bubble column- Air lift rector- Packed bed- fluidized bed- Trickle bed reactor- Industrially important reactor: Photo bio reactor, membrane bio reactor.

TEXT BOOK:

1. Enzyme Kinetics (1995) – Palmer, London: Portland Press

REFERENCE BOOKS

1. Enzyme Kinetics - Dixon , 1972, wiley publishers

2. Fundamental of Enzymology – Price &Steven , 1999-Bowker company

3. The Enzymes Vol. 1 & 2 – Boyer, 1983

4. Enzyme Structure & Mechanism – Alan Fersht, 1985, W.H. Freeman

5. Enzyme Biotechnology – Tripathi, G, 2009- ABD Publishers.

U18PCAC404	**PROCESS ENGINEERING IN BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	0	0	2
	Prerequisite – Engg Mathematics-I, Engg Mathematics –II, Principles of chemical Engineering.				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES : To study the development of bioprocesses					

COURSE OUTCOMES (COs)	
CO1	To remember the basic design of a fermenter
CO2	To understand the stoichiometry and energetics of cell growth and product formation
CO3	To acquire the knowledge of bioprocesses
CO4	To analyze various parameters to be monitored and controlled during fermentation processes
CO5	To evaluate the media for the optimization for various fermentation processes
CO6	To understand the use of fermenters in various industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNITI BASIC STOICHIOMETRY AND UNIT OPERATION 9

Basic stoichiometric calculations: mole, molar mass, normality, molarity, molality, mole fraction, mass fraction, Ideal gas law, Raoult's law, Dalton's law, Amagat's law, Average molecular weight and density. Unit operations: Milling, dehusking, polishing, evaporation, drying, mixing, extraction, filtration and centrifugation.

UNIT II STOICHIOMETRY OF BIOPROCESS 9

Unit operation & Process - Stoichiometry of Cell growth and product formation- elemental balances- degrees of reduction of substrate and biomass-available electron balances-yield coefficients of biomass and product formation-

UNIT III HEAT & MASS TRANSFER 9

Modes of heat transfer- Heat transfer through compound wall- Heat flow through cylinder-Heat exchanger- Theory of Shell and Tube heat exchanger and double pipe heat exchanger- Mass

transfer: Derivation of Diffusion of A through non diffusing B in gases and Liquids and Equimolar counter diffusion.

UNIT IV FLUID MECHANICS 9

Fluids –Types of fluid - Nature of flow – Reynold's experiment- Bernoulli's equation - Flow meters: Manometers - types of manometers —notches-Pumps: single acting and double acting pump -Centrifugal Pump.

UNIT V BIOREACTOR

Fermentor - types of bioreactor: Batch and continuous reactor, trickle bed reactor, Air lift bioreactor, fluidized bed bioreactor, photobioreactor.

Text book

1. K.A.Gavhane, 2009, "Introduction to process calculations Stoichiometry" NiraliPrakasham Publications 22nd.

Reference Books

1. K.A. Gavhane, 2009, "Fundamentals of chemical engineering" NiraliPrakasham Publications 22nd.
2. McCabe and Smith,2002, "Unit operations in Chemical Enginering", Tata McHraw Hill Pblications, 6th Ed.
3. K.A. Gavhane, 2009, "Unit operations I Fluid flow & Mechanical operations" NiraliPrakasham Publications, 17th.
4. Bhat & Vora,2001, 'Stoichiometry'', Tata McGraw Hill Ltd, III Ed.
5. Weblink: nptel

U18PCAC405	PRODUCTION OF HORTICULTURAL CROPS	L	T	P	C
	Total Contact Hours - 45	2	0	0	2
	Prerequisite – Agricultural botany, crop production				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

1. To understand the way to produce horticultural crops

COURSE OUTCOMES (COs)

CO1	To remember the history about the field of horticulture
CO2	To understand the production of fruit crops
CO3	To understand the production of plantation crops
CO4	To remember the crop production of spice crops
CO5	To understand about the production of medicinal and aromatic crops
CO6	To apply the various production methods in field

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M

	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)			
				√									
4	Approval	Academic Council, July 2018											

UNIT I: **INTRODUCTION** **9**

Horticulture – Origin, definitions – role of fruit crops in national economy - nutritive value of horticultural crops – classification of horticultural crops – Cropping systems - planting methods –Crop geometry- intercultural operations– training, pruning, and special practices - off season production – Basics of protected cultivation – Propagation– definition – methods - merits and demerits – propagation through seeds - dormancy and methods of overcoming dormancy – vegetative propagation – merits and demerits – cutting, layering, grafting and budding – rootstock influence – stock / scion relationship– micro propagation.

UNIT II: CROP PRODUCTION TECHNIQUES IN FRUIT CROPS **9**

Scope and importance of fruit crops – classification of fruit crops – area, production, productivity and export potential. Climate and soil requirements – varieties – propagation - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management. **Crops**: Mango, Banana, Grapes, Citrus (sweet orange, mandarin, acid lime), Papaya, Indian goose berry (Aonla)**,** Sapota, pomegranate, Guava, Pineapple, Jack, Apple, Pear, Plum, Peaches.

UNIT III: CROP PRODUCTION TECHNIQUES OF PLANTATION CROPS **9**

Scope and Importance of plantation crops - area and production- export potential- classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping - mulching-cover cropping -harvest- post harvest management and processing-**Crops:** Tea, coffee, rubber, coconut, arecanut, oil palm, palmyrah

UNIT IV: CROP PRODUCTION TECHNIQUES OF VEGETABLES, AND SPICES CROPS 9

Importance of vegetable and spices–area and production of vegetables in India and Tamil Nadu-Nutritive value of vegetables –classification of vegetables and spices –types of vegetable growing –Climate and soil – varieties and hybrids – propagation and planting– nutrient management – irrigation and fertigation management – weed management – cropping systems in vegetable crops - vegetable production under protected structures – maturity indices – harvest – post harvest. **Crops:** Tomato, chilli, capsicum, brinjal, bhendi, onion, gourds, potato, cassava, sweet potato, carrot, radish, beetroot, cabbage, cauliflower, amaranthus,moringa, Black pepper, cardamom, turmeric, ginger, garlic, coriander, fenugreek, cumin, fennel, clove, nutmeg, cinnamon, tamarind and vanilla.

UNIT V: CROP PRODUCTION TECHNOLOGIES OF FLOWER, MEDICINAL AND AROMATIC CROPS 9

Importance, scope, constraints and future prospects – area and production – floriculture industry - export potential of commercial flowers – protected cultivation of - Loose flowers - Soil and climate – varieties – propagation – nursery practices – planting methods – pinching, training and pruning - nutrient and water management – role of growth regulators – harvest– post-harvest management – grading and packaging, extraction of secondary metabolites. **Crops**: rose, jasmine, chrysanthemum, tuberose, crossandra,marigold,, carnation, gerbera, senna, periwinkle, glory lily, ashwagandha, medicinal coleus, aloe, Isabgol, phyllanthus, medicinal dioscorea and medicinal solanum, ocimum, mint, lemon grass, citronella, geranium, eucalyptus, palmarosa and vetiver

Reference text books

1. Kumar, N. 2014. Introduction to Horticulture. Oxford & IBH Publishing co. Pvt. Ltd.

2. Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. IIIV., Malhotra Publ. House

3. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.

4. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India, Publishing Agency, New Delhi.

5. Veeeraragavathatham, D and et al.,2004. Scientific fruit culture, Sun Associates, Coimbatore

U18PCAC406	**PLANT CELL AND TISSUE CULTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Agricultural Botany, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a knowledge about tissue culture and its applications

COURSE OUTCOMES (COs)

CO1	To remember the history of plant tissue culture
CO2	to understand the concept of somaclonal and gametoclonal variation
CO3	To understand the organization of a tissue culture lab
CO4	to remember the types of culture and its applications
CO5	to understand about protoplast culture and fusion and its applications
CO6	To apply the concept of tissue culture in crop improvement

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	L	M	L	L	M
	CO2	H	M	M	H	H						L	M
	CO3	H	M		H	H		M	H	H	L		
	CO4	H	L		H			M			L	L	M
	CO5	H	M	M	H	H					L		M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)

4	Approval	Academic Council, July 2018

UNIT I INTRODUCTION 9

History-organization of tissue culture lab-sterilization methods-lab requirements: equipments, culture vessels-culture media: constitution, types of media, preparation: MS medium, White's, Gamborg, Nitsch medium-plant growth hormones-Auxins - Cytokinins – Gibbrellins -Abscissic acid - Ethylene – Polyamines

UNIT II TISSUE CULTURE AND VARIATION 9

Tissue culture as a source of genetic variability: somoclonal and gametoclonal variation, sources and causes of variation, selection of variants-micropropagation as a tool of in vitro multiplication

UNIT III TYPES OF CULTURE 9

General terms in Tissue culture-embryogenesis and organogenesis-cytodifferentiation-callus culture-anther culture-haploid culture-embryo culture-meristem culture-single cell culture

UNIT IV PROTOPLAST CULTURE 9

Protoplast isolation, culture and fusion-selection of hybrid cells –regeneration of hybrid plants-somatic hybridization and cybridization–somatic embryogenesis and artificial seeds

UNIT V APPLICATIONS OF TISSUE CULTURE 9

Production of plants for crop improvement-secondary metabolite production through plant cell cultures-presentation of plant genetic resources-Gene conservation bank-application in plant pathology

TEXT BOOKS

1. Plant Biotechnology – S Ignacimuthu, S J Oxford and IBH, New Delhi,1996.
2. Applied Biotechnology and Plant Genetics – M Sudhir, Domain publishers & distributors, 2000

REFERENCE BOOKS

1. S.S. Purohit, Textbook of Plant Biotechnology, 2015, Bio Green Books

3. Plant Biotechnology: Recent Advances – P C Trivedi, Panima publishing corporation, 2000

U18PCAC407	**PLANT PATHOLOGY AND DISEASE MANAGEMENT**									**L**	**T**	**P**	**C**
	Total Contact Hours - 45									3	0	0	3
	Prerequisite – Microbiology												
	Course Designed by – Dept of Industrial Biotechnology												
OBJECTIVES: To provide a basic knowledge on plant diseases, symptoms and causative organisms													
COURSE OUTCOMES (COs)													
CO1	to understand the concept of pathogenesis												
CO2	to analyze the types of fungal diseases in plants												
CO3	to understand the various bacterial diseases in plants												
CO4	to understand the various aspects of viral diseases												
CO5	to remember the concept of disease management												
CO6	To apply the concept of pathogenesis in disease management												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I: INTRODUCTION ANDPATHOGENESIS 9

Plant Pathology-Definition-History of plant Pathology-causes of plant diseases-Biotic and abiotic; Pathogenesis-Mode of infection-pre penetration, penetration and post penetration; Effect of pathogen on physiological functions of the plants; Role of enzymes and toxins on disease development-Plant defense mechanisms.

UNIT II: FUNGAL DISEASES IN PLANTS 9

General characters of fungi-structure, Reproduction – outline of asexual and sexual reproduction ; Molecular phylogeny of fungi; Fungal diseases- Damping off, Downy mildews, White Rusts, Powdery Mildew, Rots, smuts, Bunt, Rust, Wilt, Head blight, Root rots, Leaf spots, Leaf blights, Anthracnoses, Galls-Symptoms-causative organisms –Pathogenesis.

UNIT III: BACTERIAL DISEASES IN PLANTS 9

General characters of Phytopathogenic bacteria ;Bacterial diseases-Blight, Leaf streak, Citrus canker, Black rot, Wilt, Brown rot, Yellow ear rot, Black leg, Fire blight of Apples and pears, Crown gall, Stalk rot, scab, Ratoon stunting of sugarcane-Angular leaf spot-Symptoms-causative organisms –Pathogenesis.

UNIT IV: VIRAL DISEASES IN PLANTS AND OTHER CAUSATIVE AGENTS 9

Viral diseases –Mosaic disease, Leaf roll, Leaf curl, Bunchy disease-Tristeza of citrus -symptoms-causative organisms-pathogenesis; General characters and symptoms of candidatus phytoplasma – spiroplasma-algae-viroids-Phanerogamic parasites, Vectors -types and Mode of spread.

UNIT V: PLANT DISEASE MANAGEMENT 9

Principles and Methods of plant disease management –Avoidance-Exclusion-Eradication of pathogens-Protection –Resistance; Management of plant diseases –Regulatory-cultural-biological-physical-chemical strategies; Seed health certification system –Resistance Breeding - Integrated disease management.

References

1. Agrios, G.N. 2005. Plant Pathology – (5th Edition). Academic Press, New York.
2. Alexopoulos,C.J., Mims,C.W. and Blackwell, M.2010 Introductory Mycology. John Wiley and Sons Ltd., N.York.
3. Alice D, and Jeyalakshmi C 2014. Plant Pathology. A.E Publications ,Coimbatore
4. Dube, H.C.2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
5. Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, Wiley E.Ltd. New Delhi.
6. Singh, R.S.1982. Plant Pathogens – The Fungi. Oxford and IBH Publishing Co., New Delhi.
7. Vidyasekaran, P. 1993. Principles of Plant Pathology –. CBS Publishers & Distributors, New Delhi.

U18MCTH401Constitution of India – Basic features and fundamental principles 2 0 0 0

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ownancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

Meaning of the constitution law and constitutionalism
Historical perspective of the Constitution of India

Salient features and characteristics of the Constitution of India

Scheme of the fundamental rights

The scheme of the Fundamental Duties and its legal status

The Directive Principles of State Policy – Its importance and implementation

Federal structure and distribution of legislative and financial powers between the Union and the States

Parliamentary Form of Government in India – The constitution powers and status of the President of India

Amendment of the Constitutional Powers and Procedure

The historical perspectives of the constitutional amendments in India

Emergency Provisions : National Emergency, President Rule, Financial Emergency

Local Self Government – Constitutional Scheme in India

Scheme of the Fundamental Right to Equality

Scheme of the Fundamental Right to certain Freedom under Article 19

Scope of the Right to Life and Personal Liberty under Article 21

U18PCAC4L1	**AGRICULTURAL MICROBIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite- Microbiology, Molecular biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES-

To provide a basic understanding of microbes and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the source of microbes and their role in biotechnology
CO2	to get the knowledge of microbial diversity classification and morphology
CO3	to know the visualization of microbes by different microscopes
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens
CO5	to get a basic knowledge of the microbial nutrition and growth
CO6	To understand about various identification methods of microorganisms

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											H	
	CO2	H						H					
	CO3	H	H										
	CO4									L			
	CO5						L						L
	CO6	H											

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

LIST OF EXPERIMENTS

1. Microscopes – handling light microscope.
2. Micrometry- measurement of microorganisms.
3. Sterilization – equipment and apparatus used for sterilization.
4. Media preparation for bacteria, fungi and actinomycetes.
5. Isolation of microorganisms-serial dilution plate technique.
6. Purification and preservation of bacteria
7. Purification and preservation of fungi.
8. Staining techniques- simple and negative staining.
9. Differential staining - Gram-staining
10. Structural staining - spore staining.
11. Morphology of bacteria- cell arrangement.
12. Growth of bacteria - turbidometric method.
13. Physiological characters of bacteria.
14. Biochemical characters of bacteria.
15. Identification of bacteria.
16. Identification of fungi

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U18PCAC4L2	PROCESS ENGINEERING LAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Bioprocess engg., Unit Operation				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES;
To provide basic knowledge about bioprocessing

COURSE OUTCOMES (COs)

CO1	to get knowledge on biomass
CO2	to know about enzyme kinetics
CO3	to understand about immobilization of enzyme
CO4	to get idea about mass transfer
CO5	to know about death kinetics
CO6	to know about product optimization

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1											H	
	CO2	H						H					
	CO3	H	H										
	CO4									L			
	CO5						L						L
	CO6	H											

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

LIST OF EXPERIMENTS

1. Estimation of biomass production
2. Plate assay for amylase enzyme.
3. Enzyme kinetics
4. Immobilization of enzyme.
5. Solid state fermentation.
6. Production of soap and analyse its properties.
7. Production of biodiesel and analyse its properties.
8. Production of biofertilizer and analyse plant growth.
9. Leaching.
10. Study of shell and tube heat exchanger.

U18MCAB407Literature, Cinema and Media (workshop, reading multiple news sources,analyze ads**)**

0 0 2 0

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description.

Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not justthe literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to

learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408 Literature & Media Group Reading (saamuhikvaachan) of classics 0 0 2 0

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

SEMESTER V

U18BSMA502	**Applied Agriculture Statistics** **(For B. Tech - Agriculture Engg. admitted from July 2018)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	**3**	**1**	**0**	**4**
	Prerequisite Course – Basic knowledge in probability and statistics				
	Course Coordinator Name & Department– P. Bhathmanaban& Department of Mathematics				
COURSE OBJECTIVE	➢ This course aims at providing the required skill to apply the statistical tools in engineering problems.				

COURSE OUTCOMES (COs)	
CO1	Understand the importance and the application of Probability in Engineering.
CO2	Summarise the Discrete and Continuous Random variables, Random Processes, and their Applications.
CO3	Apply various tools for testing the parameters based on samples
CO4	Analyse the sampling and testing the parameters.
CO5	Evaluate and analyse the variance in experiments.
CO6	Describe the basic knowledge of Statistics and its Applications.

Mapping of Course Outcomes with Program outcomes (POs)

(1/2/3 indicates strength of correlation) 3 –High, 2-Medium,1-Low

1	**COs/POs**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
2	**CO1**	2	3	1	2	2		1		2	2	3			
	CO2	3		1	1	2	2			2		2			
	CO3	3	2	2				1				3			
	CO4	2	3	2				1	1			3			
	CO5	2	3		2	2	2		1			3			
	CO6	3		2		1	1	2		2	1				
3	**Category**	Basic Science (BS)													
4	**Approval**	47th Academic Council Meeting held in Aug, 2018													

UNIT I PROBABILITY AND RANDOM VARIABLES (9+3) Hrs

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. – Simple problems.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES (9+3) Hrs

Joint distributions - Marginal and Conditional distributions – Expectation and conditional expectations. Transformation of Random Variable, Central limit theorem (for independent and identically distributed random variables)

UNIT III BASIC STATISTICS (9+3)Hrs

Measures of central tendency – Measures of dispersion – Moments, Skewness & Kurtosis – Correlation, Rank Correlation and Regression.

UNIT IV TESTING OF HYPOTHESIS (9+3) Hrs

Large sample tests based on normal distribution - Test for single mean, difference between means, standard deviation, difference between standard deviation. Tests based on t, Chi square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS (9+3) Hrs

Design of experiments Basic principles of experimental designs - Analysis of variance: ANOVA - one-way, Two-way classifications - Completely randomized design – Randomized block design - Latin square design - 2^2 Factorial Design.

TEXTBOOKS

1. S.C. Gupta &V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003.
2. S.C. Gupta and V.K. Kapoor, "Applied Statistics". Sultan Chand and Sons, New Delhi 2004.
3. P. K. Sahu, "Agriculture and Applied Statistics – I", Kalyani Publishers, New Delhi (2017).
4. P. K. Sahu& A.K. Das, "Agriculture and Applied Statistics – II", Kalyani Publishers, New Delhi (2017).

REFERENCE BOOKS

1. Veerarajan T. "Probability Statistics and Random Processes" Tata McGraw Hill, New Delhi 2003.
2. W.W. Daniel, "Biostatistics-A foundation for Analysis of Health Sciences", John Wiley and Sons, New Delhi 2000.
3. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability For Engineers", 6th Edn. Wiley India Pvt Ltd., New Delhi-2. 2010.
4. Tirupathi R. Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

U18HSBA502	**ORGANIZATIONAL BEHAVIOR**	L	T	P	C
	Total No. of contact hours: 45	3	0	0	3
	Pre-requisite:				
	Course Designed by: Dept of Management Studies				

Course Objectives	1. Understanding the basic approaches in organization 2. Knowledge on theories of Personality 3. Clear sight on the Decision Making in Groups 4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

COURSE OUTCOMES (COs)	
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour
CO2	Knowledge of the Interpersonal perception
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Familiarity with the knowledge of types of Conflicts
Category	HS
Approval	47th Academic Council Meeting held in Aug, 2018

Unit I **9 hours**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

Unit II **9 hours**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour

Unit III **9 hours**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

Unit IV **9 hours**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

Unit V **9 hours**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education

RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

U18PCAC501	PLANT GENETIC ENGINEERING	L	T	P	C

	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Molecular biology, Cell biology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of genetic engineering
CO2	to apply the concept of recombinant DNA in plant, animal and microbial systems and growth in real life situations
CO3	to get the knowledge of molecular scissors and its role in creating transgenic products
CO4	Toknow the techniques related to screen the recombinant products
CO5	to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	H	L	H
	CO2	H	M	M	H	H	M	M	H		L		
	CO3	H	M		H					H	M	L	H
	CO4	H	M			H	H	M	M		M	M	M
	CO5	H	M	M		H		M		M		L	H

3	Category	Humanities & Social Studies	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I CLONING 9

Introduction to Genetic engineering.-Restriction enzymes, Restriction sites, Linkers and adapters. Markers for screening- Vectors- Characteristics-plasmid:EcoIi -.pBR 322, Cosmid-Shuttle vectors, pblue script vectors, Expression vectors, BAC, YAC, MAC. Characterizationof recombinant clones by Southern, Northern, Western Blotting

UNIT IICONSTRUCTION OF LIBRARIES 9

Overlapping and Non overlapping DNA fragments, Genomic library- Purification and Separation of RNA. cDNA library construction, Genome mapping, Polymerase Chain Reaction– methods, types and Applications. Semi quantitative and Real time PCR,

UNIT IIINUCLEIC ACID SEQUENCING AND LABELLING 9

Nucleic acid sequencing methods-Maxam Gilbert chemical sequencing, Sanger dideoxy enzymatic method- DNA Labelling: Nick translation, RNA labeling and Fluorescent labeling and non-isotopic labeling methods

UNIT IV GENE TRANSFER IN PLANTS 9

Method of gene transfer to plants- agrobacterium mediated / chemical mediated, Biolistics. Transgenic plants- Ri and Ti plasmids, Screening of recombinants-Direct and indirect methods, Single cell proteins using fungi.

.

UNIT VAPPLICATIONS 9

Transgenic plants for insect, disease, stress & herbicide resistance – edible vaccines and plantibodies – methods of crop improvement through genetic engineering –Fruit ripening-Antisense RNA technology

TEXT BOOK

1. **1.** Adrian Slater, 2006, "Plant biotechnology", 3rd Ed,
1. Brown TA, 2000, "Gene cloning-and introduction" VNR (U.K) Co Ltd.

REFERENCE BOOKS

2. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009," Plant Biotechnology
3. Setlow JK,2004, "Genetic engineering: principles and methods" Springer.
4. Fridal R,2006, "Genetic engineering" Lerner publications.
5. LeVine H,2006, "Genetic engineering-A reference handbook" ABC-CLIO.
6. Levine AD,2009, "Cloning" The Rosen publishing group, 1st.
7. Weblink: nptel

U18PCAC502	**ENTOMOLOGY AND PEST MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Botany, crop production				
	Course Designed by – Dept. of Agricultural Biotechnology				

OBJECTIVES

To provide basic knowledge on insect pests and its management

COURSE OUTCOMES (COs)

CO1	to understand the history and importance of insects
CO2	to understand the morphology of insects
CO3	to study the anatomy and physiology of insects
CO4	to know the taxonomy of Apterygota and Exopterygota

CO5	to get a basic knowledge of Endopterygota

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H		H			
	CO2	H		H				H		H			
	CO3	H		H				H		H			
	CO4	H		H	M			H		H			
	CO5			H		H	H	H	H				H

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I HISTORY AND IMPORTANCE 9

History of Entomology in India; Position of insects in the animal kingdom and their relationship with other classes of Arthropoda; Reasons for insect dominance

UNIT II MORPHOLOGY 9

General organisation of insect body wall - structure and function, cuticular appendages, moulting; Body regions - insect head, thorax and abdomen, their structure and appendages

UNIT III ANATOMY AND PHYSIOLOGY 9

Digestive, excre

tory, respiratory, circulatory, nervous and reproductive systems in insects, sense organs and their functions, exocrine and endocrine glands; Embryonic and post embryonic development.

UNIT IV TAXONOMY OF APTERYGOTA AND EXOPTERYGOTA 9

Insect systematics; distinguishing characters of agriculturally important orders and families of Hexapoda-Apterygota (Thysanura, Diplura, Protura and Collembola);Exopterygota (Ephemeroptera, Odonata, Orthoptera, Phasmida, Dictyoptera, Embioptera, Dermaptera, Hemiptera, Isoptera, Psocoptera, Mallophaga, Thysanoptera and Siphunculata)

UNITV TAXONOMY OF ENDOPTERYGOTA 9

Distinguishing characters of agriculturally important families of Lepidoptera, Coleoptera, Diptera, Hymenoptera, Siphonaptera, Neuroptera and Strepsiptera

TEXT BOOKS:

1.Richards O.W. and R.G. Davies. 1977. *Imm's General Text Book of Entomology*. Vol.I and II. Chapman and Hall Publication, London. 1354p. {ISBN 0412 15220 7

REFERENCES:

1.Chapman, R.F. 1998. *The Insects: Structure and Function*. Fourth Edition. Cambridge University Press. 770p. {ISBN 0 521 78732 7}

2. Snodgrass, R.E. 1994. *Principles of Insect Morphology*. CBS publishers and distributors, New Delhi. 667p.
3. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
4. Srivastava, P. D. and R. P. Singh. 1997. An Introduction to Entomology. Concept Publishing

U18MCTH502UNIVERSAL HUMAN VALUES **2 0 0 0**

The objective of the course is four fold:

Sensitization of student towards self, family (relationship), society and nature.

Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
Strengthening of self reflection.
Development of commitment and courage to act.

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

U18PCAC5L1	**PLANT MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	0	0	2	1
	Prerequisite – Molecular Biology, genetic engineering				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES
To gain practical knowledge on nucleic acid isolation and its genetic manipulation

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of central dogma of biological systems
CO2	to know the procedure for DNA isolation from various sources
CO3	to study about electrophoresis
CO4	to understand the concept of restriction and ligation practically
CO5	to get a basic knowledge of transformation and mutation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	H		H	H				H
	CO2		H	H			M					M	
	CO3	H		M	M	H					M		
	CO4		L	L				L	L	L			L
	CO5			H	H		M			H		M	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

LIST OF EXPERIMENTS

1. Extraction of plant genomic DNA.
2. Extraction of Bacterial genomic DNA
3. Extraction of Animal DNA
4. Agarose gel electrophoresis.
5. Restriction Digestion of DNA.
6. Ligation of E-CoR1 digest of λDNA
7. Isolation of plasmid DNA by alkaline lysis
8. Effect of UV radiation on bacterial survival (induced mutagenesis.
9. Transformation.
10. Poly acrylamide –SDS slab gel electrophoresis of proteins

U18PCAC5L2	PLANT CELL AND TISSUE CULTURE LAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Biochemistry, Microbiology, Environmental Biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide knowledge about tissue culture and its applications

COURSE OUTCOMES (COs)

CO1	to know about the basic concepts of PTC
CO2	to understand about the sterilization methods
CO3	to get basic idea about preparation of media
CO4	to know about surface sterilization and inoculation
CO5	to get basic idea about synthetic seeds

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M	M		M	H		L	
	CO2	H	M	M	H	H		M			L	L	

	CO3	H	M		H		M	M					M
	CO4	H	M		H	H			L	M		L	M
	CO5	H	M	M	H	H	M	M			L		M
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)		Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)	
							√						
4	Approval	Academic Council, July 2018											

LIST OF EXPERIMENTS

1. Tissue culture lab practices
2. Sterilization techniques for tissue culture
3. Preparation of culture medium
4. Callus culture using *Daucus carota*
5. Invitro propagation of Rose
6. Micropropagation of Rose
7. Rooting and hardening
8. Preparation of Synthetic seeds
9. Embryo culture
10. Anther culture

Self Development

U18MCAB611SPIRITUAL, MINDFULNESS AND MEDITATION 0 0 2 0

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions:
multiple 10-day sessions may be organized over a semester.

U18MCAB612 RELIGION AND INTER-FAITH 0 0 2 0

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under 'book reading'.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

SEMESTER VI

U18PCAC601	**FERMENTATION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	0	0	2
	Prerequisite –Microbiology				

	Course Designed by – Dept. of Industrial Biotechnology

OBJECTIVES: To provide a basic knowledge of Biological processes.	
COURSE OUTCOMES (COs)	
CO1	To understand the development of bioprocess techniques.
CO2	To know about the instrumentation and control for bioprocess operations
CO3	To get idea about media formulations
CO4	To know about stoichiometry of bioprocess.
CO5	To know about various bioreactors

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H			L	L	
	CO2	H	M	M	H	H		M		M	L		M
	CO3	H			H	H	M	H	H			L	M
	CO4	H	M		H			M			L		
	CO5	H	M	M	H	H		M	M	M	L		M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
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4	Approval	Academic Council, July 2018							

UNIT –I INTRODUCTION TO FERMENTATION

History of fermentation - Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media- Upstream process.

UNIT II INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO_2- cell mass, cell number, solid-substrate fermentation and its applications.

UNIT III FERMENTATION TECHNIQUES 9

Fermentation- Definition & types - Submerged and Solid state. Fermentors& its types (Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation.

UNIT –IV FERMETATION PRODUCT 9

Production of beverages – beer and wine- vitamin B12–Antibiotics- penicillin - Bakers yeast, Details of mushroom development- Oyster (Pleurotus) and Button (Agaricus) mushroom.

UNIT –V DOWNSTREAM PROCESSING 9

Downstream process- Intercellular and extracellular- Centrifugation, filtration, Floatation-solvent extraction, precipitation- cell disruption- physical and Chemical methods.

TEXT BOOK:

1. Stanbury P T and Whitaker 1984, Principles of Fermentation Technology,
Pergamon Press. NY

REFERENCES

1. Casida, L E JR 1968 Industrial Microbiology. New Age International Publishers.
2. Prescott and Rehm 1979. Industrial Microbiology. Wiley and Sons.

U18PCAC602	**BIOFERTILIZERS AND BIOPESTICIDES**										**L**	**T**	**P**	**C**
	Total Contact Hours - 45										3	0	0	3
	Prerequisite – Agricultural microbiology													
	Course Designed by – Dept of Agricultural Biotechnology													
OBJECTIVES: To provide a basic knowledge of biofertilizers and biopesticides														
COURSE OUTCOMES (COs)														
CO1	to understand the concept of symbiotic and non nitrogen fixation													
CO2	to remember the types of diazotrophs													
CO3	To understand the protocol for the preparation of biofertilizers													
CO4	to understand the production of PSMs and mycorrhizal biofertilizers													
CO5	to understand the principles of biocontrol													
CO6	To apply the concept of biocontrol in the production of biopesticides													
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	
2	CO1	H	M	M	H		H	H	H	H	M	L	M	
	CO2	H	M	M	H							L	M	
	CO3	H				H			H	L				
	CO4	H	M				M	M				L		
	CO5	H	M	M		H				M	L			

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I SYMBIOTIC NITROGEN FIXERS **9**

Introduction-history-symbiotic and non symbiotic nitrogen fixation-Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application-Frankia biofertilizer

UNIT II NON SYMBIOTIC NITROGEN FIXERS **9**

Free living Azotobacter- free isolation, characteristics, mass inoculums, production and field application; Azospirillum isolation, characteristics, mass production-blue green algae biofertilizers-Azolla-green manuring

UNIT III MYCORRHIZAL BIOFERTILIZERS **9**

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT IV PHOSPHATE SOLUBILIZERS **9**

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field Application

UNIT V BIOPESTICIDES **9**

Biocontrol-agents of biocontrol-antagonism-biopesticides vs chemical pesticides-bacterial pesticides; *Bacillus thuringiensis*, production, Field applications-mycopesticides-viral pesticides-biological control of weeds

TEXT BOOK

1. Singh B.D, (2003), Biotechnology, Kalyani Publishers
2. R.C. Dubey, (2009), A Textbook of Biotechnology, S Chand and Company, Ltd

REFERENCE BOOK

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. 2002), Bioinoculants for sustainable agriculture and forestry, Scientific Publishers

U18HSBT601	BIOENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – microbiology, genetic engineering, biotechnology												
	Course Designed by – Dept of Industrial Biotechnology												
OBJECTIVES: To provide basic knowledge about Entrepreneurship													
COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of Entrepreneurship												
CO2	to know about time management												
CO3	to explore the avenues for financing a business venture												
CO4	to know about various company laws												
CO5	to understand Entrepreneurship in biotechnology												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	G	h	I	j	k	l
2	CO1	H		M	H	M	M	M				L	
	CO2	H	M	M	H	H		M		M	L	L	M
	CO3	H	M	M	H	H	L		H		L		M
	CO4	H	M			H		M			L	L	M
	CO5	H	M	M	H	H		M		M	L	L	M
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)		Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)
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4	Approval	Academic Council, July 2018											

UNIT I ENTREPRENEURSHIP FUNDAMENALS 9

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

UNITII DECISION MAKING AND TIME MANAGEMENT 9

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

UNIT III FINANCE AND ECONOMIC FEASIBILITY 9

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

UNIT IV COMPANY LAWS AND REGULATIONS 9

Forming company – Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9

Various business opportunities in Biotechnology – Development of Biotech companies in India – Case studies on Biotech companies and its growth

TEXT BOOK

1. Exploring Entrepreneurship: D. Allan Barefield and George F. Smith, Ettmae Westbrook, Tennesse State University, 2006

REFERENCE BOOK

Entrepreneurship fundamentals by ZobiasKollmann International journal of Technology management,2007

Company, New Delhi.

U18PCAC603	**FUNDAMENTALS OF SOIL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Agricultural microbiology				
	Course Designed by – Dept of Agricultural Biotechnology				

OBJECTIVES: To provide a basic knowledge of biofertilizers and biopesticides

COURSE OUTCOMES (COs)

CO1	to understand the production of symbiotic nitrogen fixers
CO2	to know about non symbiotic nitrogen fixers
CO3	to get idea about mycorrhizal biofertilizers
CO4	to know about PSMs and their uses
CO5	to know about biopesticides
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)

					√				
4	Approval	Academic Council, July 2018							

Unit I

Soil as a natural body, Pedological and edaphological concepts of soil. Components of soil. Soil genesis: Composition of Earth's crust- soil forming rocks and minerals – Primary and secondary minerals. Weathering of rocks and minerals. Factors of soil formation. Soil forming processes. Soil Profile.

Unit II

Soil physical properties: Soil texture, structure, density and porosity, soil colour, consistence and plasticity. Soil water retention, movement and availability. Soil air, composition, gaseous exchange-problem and its effect on crop growth. Source, amount and flow of heat in soil, Soil temperature and crop growth.

Unit III

Soil physico chemical and chemical properties: Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability. Electrical conductivity. Soil colloids - inorganic and organic. Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation.

Unit IV

Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties. Soil Biology: Soil organisms : macro and micro organisms, their beneficial and harmful effects. Soil enzymes.

UNIT V

Soil pollution – Types and behaviour of pesticides. Inorganic contaminants. Prevention and mitigation of soil pollution.

ESSENCE OF INDIAN KNOWLEDGE TRADITION-Pt-1

भारतीयविद्यासार - 1

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-1 focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course contents

- Basic Structure of Indian Knowledge System: अष्टादश विद्या – ४ वेद, ४ उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्व वेद, स्थापत्य आदि), ६ वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद), ४उपाङ्ग (न्याय शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health Care
- Case studies

U18MCTH604 Essence of Indian knowledge Tradition 2 0 0 0

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai.5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan.
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan.
- Fritzof Capra, *Tao of Physics*.
- Fritzof Capra, *The Wave of Life*.
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkatta.
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, VidyanidhiPrakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, VidyanidhiPrakashan, Delhi 2016
- P B sharma (English translation), *ShodashangHridayam*

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

U18PCAC6L1	FERMENTATION TECHNOLOGY LAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Bioprocess Engg., Unit Operation				
	Course Designed by – Dept. of Agricultural Biotechnology				

OBJECTIVES: To provide basic knowledge about bioprocessing

COURSE OUTCOMES (COs)

CO1	to get knowledge on biomass
CO2	to know about enzyme kinetics
CO3	to understand about immobilization of enzyme
CO4	to get idea about mass transfer
CO5	to know about death kinetics
CO6	to know about product optimization

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	M		M		H	L		M
	CO2	H	M	M	H	H			M			L	
	CO3	H	M	M	H			M			L	L	M
	CO4	H	M	H	H	H			H	M		L	M
	CO5	H	M	M		H	L	M			L	L	
	CO6	H		H	H	H		M			L		M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				

4	Approval	Academic Council, July 2018

LIST OF EXPERIMENTS

1.Fermentative production of amylase by *Aspergillus niger*.
2. Production of wine and analyse its properties.
3. Brewing of beer and analyse its properties
4. Production of Antibiotic Bacitracin by bacillus sp.
5. Production of Vitamin B_{12}.
6. Cultivation of mushroom *in vitro* studies.
7. Fermentation of citrus juices.
8. Bio-ethanol production
9. Production of probiotics from lactic acid bacteria.
10. Operational procedures of bioreactors.

11. Bio-ethanol production by using *Zymomonasmobilis*.
12. Bio-surfactant production
13. Production of probiotics from lactic acid bacteria.

U18PCAC6L2	BIOFERTILIZERS AND BIOPESTICIDES LAB	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Microbiology, pathology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide basic knowledge about preparation of biofertilizers and biopesticides

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of preparation of biofertilizers
CO2	to know about Rhizobial, Azotobacter and Azospirillum biofertilizers
CO3	to know the protocol for preparation of PSM and mycorrhizal biofertilizers
CO4	to know about bacterial pesticides
CO5	to study the preparation of mycopesticides

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	G	h	I	j	k	l
2	CO1	H		M	H	M	M	M				L	
	CO2	H	M	M	H	H		M		M	L	L	M
	CO3	H	M	M	H	H	L		H		L		M
	CO4	H	M			H		M			L	L	M
	CO5	H	M	M	H	H		M		M	L	L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
								√	

4	Approval	Academic Council, July 2018

LIST OF EXPERIMENTS

1. General protocol for production of biofertilizers and biopesticides
2. Preparation of Rhizobial biofertilizer
3. Preparation of Azotobacter biofertilizer
4. Preparation of Azospirillum biofertilizer
5. Preparation of Frankia Biofertilizer
6. Preparation of Blue green algae biofertilizer

7. Preparation of Azolla
8. Preparation of PSMs
9. Preparation of mycorrhizal biofertilizer
10. Biocontrol agents
11. Preparation of Bacillus thuringiensis biopesticides
12. Preparation of Mycopesticides

U1LPCAC6L3	**CROP PRODUCTION LAB- AGRICULTURAL CROPS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – crop production of Agricultural crops				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide knowledge about production of crops

COURSE OUTCOMES (COs)

CO1	to know about land preparation
CO2	to know about nursery preparation
CO3	to understand about fertilizer and pesticide application
CO4	to get basic idea about harvesting and post harvesting
CO5	to get basic idea about yield calculation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

LIST OF EXPERIMENTS

1. Tillage and land configuration
2. Seed treatment and sowing
3. Nursery preparation
4. Fertilizer schedule calendar
5. Weeding
6. Pesticide application
7. Harvesting
8. Post harvesting
9. Storage
10. Yield calculation

Self Development

U18MCAB611SPIRITUAL, MINDFULNESS AND MEDITATION 0 0 2 0

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions:
multiple 10-day sessions may be organized over a semester.

U18MCAB612 RELIGION AND INTER-FAITH 0 0 2 0

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under 'book reading'.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

SEMESTER VII

U18PCAC701	**BIOTECHNOLOGY OF BIOTIC AND ABIOTIC STRESS TOLERANCE**									**L**	**T**	**P**	**C**
	Total Contact Hours - 45									3	0	0	3
	Prerequisite – Agricultural Botany												
	Course Designed by – Dept of Industrial Biotechnology												
OBJECTIVES: To provide a basic knowledge on abiotic and biotic factors and their effect on plants													
COURSE OUTCOMES (COs)													
CO1	to understand the stress factors in plants												
CO2	to know about the insect pest resistance in plants												
CO3	to understand about plant pathogen interactions												
CO4	to study the various aspects of biotic stress tolerence												
CO5	to understand the abiotic stress tolerence												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
							√						

4	Approval	Academic Council, July 2018

UNIT I INTRODUCTION 9

Prospects & Perspective of Biotic & abiotic stress resistant plants, Genetics of host-pathogen interactions, Mechanism of plant resistance- Role of jasmonates and salicylic acid in systematic resistance induction on wounding

UNIT II INSECT PEST RESISTANCE 9

Insect pest resistance – Structural/ morphological changes; Protease and amylase inhibitors; polyphenol oxidases; peroxidases; lectins; chitinase; seed proteins; their limitations and significance in multi-gene pyramiding. Vertical and Horizontal resistance to pathogens

UNIT III HOST PATHOGEN INTERACTIONS 9

Hypersensitive host response (HRGP) and apoptosis in relation to plant defense- Virulence-Avirulence in host–pathogens interaction- Race specific Resistance Gene Analogues (RGAs)-Pathogenesis related proteins – groups with examples (Glucanases; chitinases; osmotin, chitin binding proteins; thaumatin like proteins; micropeptidal defensins; phytoallexins) and their role.

UNIT IV BIOTIC STRESS TOLERANCE 9

Role of Phenylalanine ammonia lyase, callose synthases, detoxification for pathogen resistance- RIP-Field testing of transgenic for fungal, bacterial, viral and pest resistance-Prospects and perspectives- Biopesticides-Developing antagonistic strains suitable for varying stress conditions.

UNIT V ABIOTIC STRESS TOLERENCE 9

Biochemical basis of abiotic stresses namely osmotic (drought, salinity), temperature, heavy metals, air and water pollutants, synthesis and functions of proline and glycine betaine in stress tolerance interaction between biotic and abiotic stresses; stress adaptation. Reactive oxygen species and biotic and abiotic stress, antioxidants, enzymes defense system- Role of calcium, nitric oxide and salicylic acid in plant development- Molecular strategies for imparting tolerance against biotic and abiotic stress

Text book:

- Li PH & Sakai A. 1987. Plant Cold Hardiness. Liss, New York Luginpill P. 1969.
- Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.
- Maxwell FG & Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons.
- Painter RH. 1951. Insect Resistance in Crop Plants. MacMillan, New York.
- Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.

Reference :

1. Verma DPS & Kohn TH. 1984. Genes Involved in Microbe-Plant Interactions. Springer Verlag.
2. Molecular Plant-Microbe Interactions. Journal Published by APS.
3. Basra AS. 1997. Stress Induced Gene Expression in Plants. Harwood Academic Publ.
4. Chessin M, DeBorde D &Zipf A. 1995. Antiviral Proteins in Higher Plants. CRC Press.
5. Crute IR, Burdon JJ & Holub EB. (Eds.). 1997. Gene-for-Gene Relationship in Host-Parasite Interactions. CABI.
6. Hopkins WG &Huner NPA. 2004. Introduction to Plant Physiology. John Wiley & Sons.
7. Salisbury FB & Ross C. 1992. Plant Physiology. 4th Ed. Wadsworth Publ. Taiz L & Zeiger E. 2006. Plant Physiology. 4th Ed. Sinauer Associates.
8. Kosuge T & Nester EW. 1989. Plant-Microbe Interactions: Molecular and Genetic Perspectives. Vols I-IV. McGraw Hill.

U18PCBT702	RESEARCH METHODOLOGY AND INSTRUMENTATION	L	T	P	C
	Total Contact Hours - 45	2	0	0	2
	Prerequisite – Biochemistry, microbiology, molecular biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about various instrumentation techniques and data documentation

COURSE OUTCOMES (COs)

CO1	to understand the biochemical analysis
CO2	to know about spectroscopic and microscopic techniques
CO3	to know about the separation techniques
CO4	to get ideas about ethical issues related to research
CO5	to know about data documentation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H	H	M	M	M
	CO2	H	M	M	H	H		H			L	L	
	CO3	H	M	H	H	H		M	H		M		M
	CO4	H	M	H	H	H	H	H		M		M	H
	CO5	H	M	M	H	H		M	H		L	L	M
	CO6	H	H	H	H	H		H		M	L		

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
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UNIT I BASIC PRINCIPLES FOR BIOCHEMICAL ANALYSIS 9

Introduction – preparation of organ and tissue samples for analysis – cell disruption methods – physiological solutions: buffers and growth media for plants, animals and microbes – Medium standardization - cell sorting, isolation and enumeration techniques – cryopreservation – elucidating metabolic pathways by tracer studies.

UNIT II SPECTROSCOPIC AND MICROSCOPY TECHNIQUES 9

Introduction – UV – visible spectroscopy – NMR spectroscopy – IR and Raman spectroscopy – atomic spectroscopy - Introduction to microscopy – Election microscopy –ultramicrotome- phase contrast microscopy – Fluorescent and confocal microscopy.

UNIT III SEPARATION TECHNIQUES 9

Introduction to chromatography and electrophoresis – gel filtration – ion exchange – affinity – GC – HPLC - partition chromatography – electrophoresis of proteins and nucleic acids – immune precipitation techniques – ELISA.

UNIT IV ETHICAL ISSUES IN BIOTECHNOLOGY 9

Legal and socio economic impacts of biotech research – bio safety regulation – r-DNA guidelines- issues involved in experimenting with animals – Experimental protocol approvals – contaminant levels and environmental effects- impact of GM organisms and GM foods – IPR and patents.

UNIT V DATA ANALYSIS AND DOCUMENTATION 9

Sampling concepts for statistical analysis – Mean, median, standard deviation, standard error – ANNOVA – Guidelines for thesis writing: literature collection methods – writing of abstract, introduction and review of literature – results, discussion and summary – guidelines to publish articles in journals.

TEXT BOOKS

1. Keith Wilson and John Walker,2004, Practical biochemistry, Principles and techniques – Cambridge publication
2. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.

REFERENCE BOOKS

P. Ramadass, 2009, Research and writing: Across the disciplines, MJP publishers.

U18PCAC702	FOOD BIOTECHNOLOGY	L	T	P	C

	Total Contact Hours – 45	3	0	0	3
	Prerequisite – microbiology, pathology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: The students understand concepts involved in microbial contamination of food and methods to control the food preservation

COURSE OUTCOMES (COs)

CO1	To understand the factors responsible for food spoilage
CO2	To investigate the microbes involved in the food spoilage
CO3	To analyze the techniques by which the food is preserved
CO4	To study the different toxins produced by the bacteria and fungi
CO5	To study the different food products by using the microbes as a source

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	G	h	I	j	k	l
2	CO1	H		M	H	M	M	M				L	
	CO2	H	M	M	H	H		M		M	L	L	M
	CO3	H	M	M	H	H	L		H		L		M
	CO4	H	M			H		M			L	L	M
	CO5	H	M	M	H	H		M		M	L	L	M
	CO6												

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
								√	

4	Approval	Academic Council, July 2018

UNIT I INTRODUCTION **9**

Food and Microorganisms – Important microorganisms in food (Bacteria, Mold and yeasts); Factors affecting the growth of microorganisms in food – pH, moisture, oxidation – Reduction potential , Nutrient content and Inhibitory substances and biological structure.

UNIT II FOOD PRESERVATION **9**

Principles of food preservation – General principles and application methods – Asepsis – Techniques of removal – use of temperature (low & high) - Drying, radiation and chemical preservatives

UNIT III FOOD SPOILAGE AND ITS CAUSES 9

Spoilage of food – cereals, vegetables, fruits, egg and milk – canned foods and sea foods.

UNIT IV FERMENTED FOODS 9

Fermented food – pickled cucumber, Sauerkraut- soysauce, Bread, Idli – Fermented dairy products – Yoghurt and cheese.

UNIT V FOOD BORNE DISEASES 9

Food borne diseases & Food Quality control Measures – Food poisoning and Food borne infections – Bacterial and Mycotoxins- Investigation of food poisoning outbreaks- food standards, quality control- HACCP, FDA, WHO

References

1. Frazier. W.C and D.C Westhoff. 1978. Food Microbiology. 3rd ed. Tata Macgraw Hill publishing Co., New Delhi.

2. Jay,J.M .1991 . Modern Food Microbiology 4th edition, Van Nostra and Rainhokdd Co.

3. Adams. M. R and M. D Moss . 1995. Food Microbiology . New Age International limited.

Roday. S. Food Hygeine and Sanitation. Tata Mcgraw Hill Publications.1998.

U18PCAC7L1	**FOOD BIOTECHNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide basic technologies involved in food processing

COURSE OUTCOMES (COs)

CO1	To know about preservation techniques
CO2	to understand basic concepts in sterilization of food products
CO3	to know about various dryers
CO4	to know about the mixing equipment for various products
CO5	to know about various preservation techniques for food products

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H		L	L	
	CO2	H	M	M	H	H		M		M	L	L	
	CO3	H	M		H	H		M				L	M
	CO4	H	M		H		L				M	L	M
	CO5	H	M	M	H	H		M	M		L		
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)
							√						
4	Approval	Academic Council, July 2018											

LIST OF EXPERIMENTS

1. Isolation, identification of storage microflora from food stuffs/vegetable/fruit
2. Food colorants from microbes and their separation by HPTLC
3. Estimation of carotenes and xanthophylls from fruits/vegetables
4. Extraction and estimation of antioxidant in vegetables/fruits/food
4. Extraction and Characterization of Gluten
5. Extraction and Characterization of chitin
6. Estimation of caffeine from tea/coffee
7. Estimation of phytic acid from grains
8. Estimation of trypsin inhibitor
9. Estimation of capsaisin
10. Extraction of alginate from red algae

U1LPCAC7L2	**CROP PRODUCTIONLAB- HORTICULTURAL CROPS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – crop production ofHorticultural crops				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide knowledge about production of crops					
COURSE OUTCOMES (COs)					
CO1	to know about land preparation				
CO2	to know about nursery preparation				
CO3	to understand about fertilizer and pesticide application				
CO4	to get basic idea about harvesting and post harvesting				

CO5	to get basic idea about yield calculation												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)	
							√						
4	Approval	Academic Council, July 2018											

LIST OF EXPERIMENTS

11. Tillage and land configuration
12. Seed treatment and sowing
13. Nursery preparation
14. Fertilizer schedule calendar
15. Weeding
16. Pesticide application
17. Harvesting
18. Post harvesting
19. Storage
20. Yield calculation

U18MCAB713 Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

0 0 2 0

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing different

aspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.
To help the students to understand the importance of non-verbal aspects of effective communication.
To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.
To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

Motivational lectures

Group Discussions/activities

Case Study

Games/Stimulation Exercises

Role-Playing
Mindfulness training.

U18MCAB714NATURE CLUB (bird watching, recognizing plants at institute/at home, recognizinglocal animals, appreciating biodiversity) **0 0 2 0**

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18MCAB815INNOVATION **0 0 2 0**

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance.

PROFESSIONAL ELECTIVE I

U18PEAC011	**FUNDAMENTALS OF AGRONOMY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Immunology, Life Science				
	Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers					
COURSE OUTCOMES (COs)					
CO1	to understand the fundamentals of immune system				
CO2	to apply the techniques for antigen and antibody reaction				

CO3	to give the mechanism of immune response against antigens
CO4	to know the natural barrier against pathogens
CO5	to get a basic knowledge of the applications of immunology in transplantation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

Unit - I:

Agriculture - Definition - Importance and scope - Branches of agriculture - Evolution of man and agriculture - History of agricultural development in the World and India.

Unit - II:

Agriculture heritage - Agriculture in ancient India - Chronological agricultural technology development in India - Kambar Aer Ezhupathu - Development of scientific Agriculture - National and International Agricultural Research Institutes in India - Indian agriculture.

Unit - III:

Agronomy - Definition - Importance - Meaning and scope - Agro-climatic zones of Tamil Nadu - Agro ecological zones of India - Crops and their classification - Economic and agronomic

- Major crops of India and Tamil Nadu - Major soils of Tamil Nadu - Factors affecting crop production - climatic - edaphic - biotic - physiographic and socio economic factors.

Unit - IV:

Tillage - Definition - Types - Objectives - Modern concepts of tillage - Main field preparations - Seeds - seed rate - sowing methods - Crop establishment methods - Planting geometry and its effect on growth and yield - After cultivation -Thinning - Gap filling - Weeds - Definition - Weed control methods.

Unit - V:

Manures and fertilizers (organic, in-organic, green manure) - time and method of application - Irrigation - Principles and concepts - Cropping patterns and cropping systems - Sustainable agriculture - integrated farming systems - Organic agriculture - Principles and concepts - Dry farming - Principles and concepts.

U18PEAC012	**FARMING SYSTEM AND SUSTAINABLE AGRICULTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite- microbiology				
	Course Designed by – Department of industrial biotechnology				

OBJECTIVES: To study the applications of microbiology in industries

COURSE OUTCOMES (COs)

CO1	To learn about bioreactors
CO2	To study the maintenance of microbial cells
CO3	To study the downstream processing of microbial products
CO4	To know the enzymes produced by microbes
CO5	To study about microbial fuel cells

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M

	CO5	H	M	M	H	H		M		L			L	L					
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)		Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)				
							√												
4	Approval	Academic Council, July 2018																	

Farming system-scope, importance, and concept; Types and systems of farming system and factors affecting types of farming; Farming system components and their maintenance; Cropping system and pattern, multiple cropping system, efficient cropping system and their evaluation; Allied enterprises and their importance, tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture, problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability; Integrated farming system, historical background, objectives and characteristics, components of IFS and its advantages, site specific development of IFS model for different agro-climatic zones; Resource use efficiency and optimization techniques, resource cycling and flow of energy in different farming system, farming system and environment; Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

	PRINCIPLES OF FOOD SCIENCE AND NUTRITION	**L**	**T**	**P**	**C**
U18PEAC013	Total Contact Hours - 45	3	0	0	3
	Prerequisite- Botany, Environmental studies				
	Course Designed by – Department of Industrial biotechnology				

OBJECTIVES

To learn about the conservation of biodiversity

COURSE OUTCOMES (COs)

CO1	to understand what is diversity
CO2	to learn about the threats to diversity
CO3	to know the methods of conservation of diversity
CO4	to learn the sustainable methods of diversity

CO5	to have a knowledge about various policies												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	J	k	L
2	CO1	M							H			H	
	CO2				M		H						
	CO3										M		
	CO4		M						H				
	CO5					M							
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Professional Elective (PE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
				√									
4	Approval												

Unit I:Principles of Food Science and Nutrition

Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid. Methods of cooking - moist, dry and microwave - principles, merits and demerits. Importance and scope of nutrition – relation of nutrition to health.

Unit -II:Carbohydrate, Protein and Fat

Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA). Energy value of foods – determination. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention. Deficiency states of protein, carbohydrate and fat nutrition – signs and symptoms.

Unit III:Vitamin and Mineral Nutrition

Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements.

Unit IV:Food Preservation and Processing

Introduction – preservation by sugar - processing of jam, squash, jelly, marmalade and beverages. Preservation by using salt, chemicals, dehydration technology, canning technology, preservation by low temperature and irradiation techniques. Processing of puffed, flaked and extruded products. Quality control of raw and processed products.

Unit V:Food Quality and Safety

Food packaging materials – requirements – methods – nutrition labeling. Food adulterants and their detection methods. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

TEXT BOOKS

1. Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi.

2. Srivastava, R.P., and Sanjeevkumar. S. 2013. Fruit and Vegetable preservation. International Book Distributing Co. Lucknow.
3. Srilakshmi .B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi.

PROFESSIONAL ELECTIVE II

U18PEAC021	PRINCIPLES OF SEED TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – General biology, Cell biology, Agrl. Botany				
	Course Designed by – Dept of Biotechnology				

OBJECTIVES: To provide a basic knowledge about seeds its quality, handling and production methods

COURSE OUTCOMES (COs)

CO1	to understand basic concepts of seed and its quality
CO2	to know about the seed production principles
CO3	to know about production of seeds of agricultural crops
CO4	to know about production of seeds of vegetable crops
CO5	to understand the post harvest handling of seeds

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	L	L	H
	CO2	H	M	M	H	H	H		H	H	M	H	
	CO3	H			H				M	M	L	L	
	CO4		M	H	H	H	M	M	L	M		M	H
	CO5		M	M	H	H	M	M	M	M		L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
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4	Approval	Academic Council, July 2018							

UNIT I - INTRODUCTION TO SEED AND SEED QUALITY 9

Seed - definition - Seed structure - Seed development and maturation - Germination -phases of seed germination - Dormancy - types of seed dormancy - Seed senescence - causes of seed

senescence - Seed quality characteristics - significance - Classes of seed - Generation system of seed multiplication in seed supply chain .

UNIT II - PRINCIPLES OF SEED PRODUCTION 9

Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period - Causes of varietal deterioration and maintenance - Genetic and agronomic principles of seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids.

UNIT III - SEED PRODUCTION TECHNIQUES OF AGRICULTURAL CROPS 9

Floral biology and pollination behavior - seed production techniques of rice, maize, sorghum and bajra varieties and hybrids - redgram varieties and hybrids - blackgam and greengram varieties - groundnut and sesame varieties - sunflower, castor and cotton varieties and hybrids – Bt cotton.

UNIT IV - SEED PRODUCTION TECHNIQUES OF VEGETABLE CROPS 9

Floral biology and pollination behavior - seed production techniques of tomato, chillies, brinjal, bhendi, onion, snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.

UNIT V - POST HARVEST SEED HANDLING TECHNIQUES 9

Threshing - methods - Drying - methods of seed drying - advantages and disadvantages -Seed processing – definition - importance - Seed cleaning and grading - upgrading - equipments - working principles - Seed treatment - importance - types - Seed invigouration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

Text books

1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
2. Bhaskaran, M. *et al.,* 2004. Principles of seed production. Scientific Publishers, Ludhiana.

U18PEAC022	**POST-HARVEST AND FOOD ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – General biology, Cell biology, Agrl. Botany				
	Course Designed by – Dept of Biotechnology				
OBJECTIVES: To provide a basic knowledge about seeds its quality, handling and production methods					

COURSE OUTCOMES (COs)	
CO1	to understand basic concepts of seed and its quality
CO2	to know about the seed production principles
CO3	to know about production of seeds of agricultural crops
CO4	to know about production of seeds of vegetable crops
CO5	to understand the post harvest handling of seeds

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	L	L	H
	CO2	H	M	M	H	H	H		H	H	M	H	
	CO3	H			H				M	M	L	L	
	CO4		M	H	H	H	M	M	L	M		M	H
	CO5		M	M	H	H	M	M	M	M		L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I: POST HARVEST LOSSES **9**

Post harvest losses – causes and estimates – unit operations of crop processing – moisture content – methods of estimation - engineering properties of grains – mass, volume, density, porosity, sphericity – Thermal properties- applications .

Unit II: Threshing, cleaning and grading

Threshing – threshers for different crops - parts, terminology – operational safety and maintenance - winnowing – manual and power operated winnowers- cleaning, grading and sorting - types of screens - air screen cleaners- construction and operation-care and maintenance –Screen effectiveness-construction and working principles of spiral separator, magnetic separator, specific gravity separator, colour sorter and inclined belt separator.

Unit III: Shelling, drying and storage

Shelling equipments - maize sheller, husker sheller, hand and power operated groundnut decorticator - construction and working – performance evaluation - grain drying – principles - advantages - types - batch and continuous, mixing and non mixing – LSU drier – construction

and operation - performance of dryers - storage of food grains – factors affecting storage, traditional and improved methods - modified atmosphere storage.

Unit IV: Cereals, pulses and oilseed processing

Rice processing – Parboiling- traditional and modern methods - , modern rice milling – Size reduction – principles- equipment used- wheat milling – process flow chart – roller flour mill - construction and operation - pulse milling - wet, dry and CFTRI methods of pulse milling – equipment – construction and operation - oilseed processing – methods and machineries used – ghani, rotary and expeller - filter press – construction and operation – solvent extraction process.

Unit V: Material handling and Food Plant layout

Material handling equipments – bucket elevator, screw conveyor, belt conveyor – construction and operation –Food plant location – selection- layout-types- Food Packaging- requirements- types- Packaging of raw and processed foods.

U18PEAC023	**DAIRY PROCESS TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Microbiology				
	Course Designed by – Agricultural Biotechnology				

OBJECTIVES

To learn the techniques involved in the processing of dairy products

COURSE OUTCOMES (COs)

CO1	To remember the ways to preserve milk
CO2	To understand the different types of processing of milk and its products
CO3	To analyze the presence of different contaminants in milk products
CO4	To understand the methods to produce powdered milk products
CO5	To analyze ways to increase the shelf life of milk and its products
CO6	To remember the ways to sanitize the dairy equipments

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	H	L	H
	CO2	H	M	M	H	H	M	M	H		L		
	CO3	H	M		H					H	M	L	H
	CO4	H	M			H	H	M	M		M	M	M
	CO5			M		H		M		M		L	H

	CO6	H				H			M				M
3	Category	Humanities & Social Studies	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)				
					√								
4	Approval	Academic Council, July 2015											

UNIT I PRESERVATION OF MILK **9**

Preservation of raw milk: effects on physicochemical, microbial and nutritional properties of milk and milk products, preservation of raw milk by chemical preservatives; thermal processing for preservation.

UNIT II PROCESSING OF MILK **9**

Methods of determining lethality of thermal processing, UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, effect on milk quality; techno- economic considerations; retort processing.

UNIT III BACTOFUGATION AND BACTOTHERM **9**

Principles and equipment for bactofugation and Bactotherm processes, Microfluidization of milk: Principle, equipment, effects and applications, Homogenization and their applications in dairy industry.

UNIT IV DRYING OF MILK **9**

Dehydration: advances in drying of milk and milk products; freeze concentration, freeze dehydration: physicochemical changes during freeze drying and industrial developments.

UNIT V SHELF LIFE OF MILK PRODUCTS **9**

Sorption behaviour of milk foods, control of water activity of different milk products in relation to their chemical; microbiological and textural properties; hurdle technology and its application in development of shelf-stable and intermediate-moisture foods, Use of carbonation in extending the shelf life of dairy products-Cleaning and sanitization of dairy equipment: biological; detergents; Automation; Ultrasonic techniques in cleaning; bio-detergents, development of sanitizers- heat; chemical; radiation, mechanism of fouling and soil removal; Bio-films, assessing the effectiveness of cleaning and sanitization of dairy products.

Text Books

1. Burton H. 1998. Ultra-high Temperature Processing of Milk and Milk Products. Elsevier.
2. Fellow P. 1988. Food Processing Technology. Elliss Horwood Ltd.

3. Gould GW. 1995. New Methods of Food Preservation. Blackie.

Reference Books

1. IDF Bulletin 1981. New Monograph on UHT Milk. Document No. 133, Intern. Dairy Fed., Brussels.
2. Smit G. 2003. Dairy Processing – Improving Quality. CRC-Woodhead Publ.
3. Troller JA & Christian HB. 1978. Water Activity and Food, Food Science and Technology. A Series of Monograph Academic Press, London.
4. Walstra P, Geurts TJ, Noomen A, Jellema A & Van Boekel MAJS. 1999. Dairy Technology – Principles of Milk Properties and Processes. Marcel Dekker

U18PEAC051	**BIOREMEDIATION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide basic knowledge about the bioremediation techniques

COURSE OUTCOMES (COs)

CO1	To know about the types of bioremediation
CO2	to understand basic techniques in bioremediation
CO3	to know about bioremediation of chlorinated compounds
CO4	to know about the nuclear waste bioremediation
CO5	to know about remediation of oil spills

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	L	M	L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
						√			
4	Approval	Academic Council, July 2018							

UNIT I BIOREMEDIATION **9**

Types of Bioremediation, Factors affection Bioremediation.BioremediationMechanisms.Limitations of Bioremediations. Microbes for Bioremediation :EssentialChararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques :Insitu&Exsitu bioremediation techniques. Phytoremediation

UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES 9

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation.

UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS 9

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

UNIT IV NUCLEAR WASTE BIOREMEDIATION 9

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION 9

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance &tolerance ;Microbial transformation; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – Biosurfactants. Advantages of biosurfactants over chemical surfactants- Biotechnology and oil spills; Improved oil recovery.

REFERENCES

1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles andApplications"* McGraw-Hill, 2001.
2. Phillip L. Buckingham, Jeffrey C. Evans," *Hazardous Waste Management"* Waveland Pr Inc; Reissue edition 1, 2010.
3. S. K. Agarwal, *"Environmental Biotechnology*", APH Publishing, 2000
4. Martin Alexander, "*Biodegradation & Bioremediation",* Academic press, 1999.

5. Karrely D., Chakrabarty K., Omen G.S, "*Biotechnology and Biodegradation*", Portfolio Pub. Co., 1990.

P. Rajendran, P. Guansekaran, "*Microbial Bioremediation*", Mjp Publishers, 2011.

U18PEBT031	FOOD PROCESS TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Microbiology, Bioprocess technology, Heat and mass transfer				
	Course Designed by – Dept. of Agricultural Biotechnology				

OBJECTIVES

To provide basic technologies involved in food processing

COURSE OUTCOMES (COs)

CO1	To know about preservation techniques
CO2	to understand basic concepts in sterilization of food products
CO3	to know about various dryers
CO4	to know about the mixing equipment for various products
CO5	to know about various preservation techniques for food products
CO6	to understand the microbiological aspects in food process

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M				L	M
	CO2	H	M	M	H	H			H	M	L	L	
	CO3	H	M		H	H		H				L	M
	CO4	H	M		H			M	L		L	L	M
	CO5	H	M	M	H	H		H		M	L	L	
	CO6	H			H	H	L	M			L		M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
					√				
4	Approval	Academic Council, July 2018							

UNIT I PHYSICAL TREATMENT OF FOOD 9

Thermal, electrical and rheological properties- Heat processing- Methods of applying heat to food - sterilization - Thermo bacteriology- dehydration and drying - free moisture - equilibrium moisture content- water activity- classification of dryers- tray, and freeze dryers, osmotic dehydration - foam mat drying- extrusion coking.

UNIT II BLENDING METHODS 9

Mixing of solids, Pastes and liquids - Characteristics of mixtures-Blending -emulsification- equipments - liquid, pastes, and plastic masses - dry powders - criteria of mixer effectiveness- mixing index

UNIT III PRESERVATION OF FOOD 9

Concentration - freeze concentration - freezing and storage of frozen products - low temperature preservation - irradiation of food products - microwave heating - dielectric heating of foods.

UNIT IV DAIRY FOODS 9

Physics and chemical properties of milk and their effect on design - heaters - coolers -heat exchange equipments - storage tanks - can washers - pasteurization - principles and methods - equipments - LTLT - HTST - UHT pasteurization - CIP unit -Homogenization - Theory and working of homogenizers - bottle fillers and cappers -cream separation - principles - types of separator - classifiers - butter churns - cheese plant equipments - ice cream freezers - drying equipments - drum drier and spray drier -membrane concentration equipments.

UNIT V FOOD MICROBIOLOGY 9

Food microbiology: food spoilage, food borne diseases, infections, intoxifications, utilization of microorganisms in food industries, Nutraceuticals. Quality control, Case studies on biotechnology in the evaluation of food quality.

Total No. of Periods: 45

Text Books

1. Lehninger and Beverlov, 2002, "Food Process Engineering". Reidal Publishing Co. Holland
2. Yin H.Hui, 2006, "Handbook of food science, technology and engineering" Wiley, Newyork, 2nd ed

Reference Books

1. Tucker & Woods, 1995, "Enzymes in food processing" Springer, 5thed.
2. Hamm &Hammilton, 2000, "Edible oil processing" Academic Press 5th ed
3. Fellows, 2009, "Food processing technology" 21th ed
4. Heldman, 2007,"Hand book of food engineering" CRC Press 2nd ed
5. P.G. Smith, 2003, "Food Process Engineering" Academic Plenum Pub, New York 1st ed
6. Srilakshmi,2005, "Food Science" MJP Publiashers, 3rd ed

Weblink: nptel

U18PEAC041	GREENHOUSE TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Production of Agricultural crops/Production of Horticultural				

	crops
	Course Designed by – Dept. of Agricultural Biotechnology

OBJECTIVES

To know about the concept and design of greenhouses

COURSE OUTCOMES (COs)

CO1	to understand the classification of biological databases and its role in research
CO2	to apply the concept of genomics of different organism, gene expression and mapping situations
CO3	to know the tools for gene identification and prediction
CO4	to know the structural elucidation and prediction of proteins
CO5	to get a basic knowledge of techniques related to proteomics
CO6	To know about bioinformatics tools

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	M		L	L	M
	CO4	H	M		H	H		M		M	L	L	M
	CO5	H	M	M	H	H		M	L		L	L	M
	CO6	H			H	H		M			L	L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
						√			
4	Approval	37th Meeting of Academic Council, May 2015							

UNIT I INTRODUCTION 9

Types of green house, importance, functions and features of greenhouse- Scope and development of green house technology

UNIT II GREENHOUSE DESIGN 9

Location, planning of various components of green house- Design criteria and calculation- Construction material, covering material and its characteristics, growing media, green house irrigation system- nutrient management

UNIT III GREENHOUSE ENVIRONMENT 9

Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment.

UNIT IV GROWING PLANTS 9

Phytotrons, fertigation, roof system, containers and benches-Growing of ornamentals and vegetables under protected environment, physiology of plants in green house, pest and disease control.

UNIT V REQUIREMENTS AND PRACTICES 9

Various containers used for protected cultivation of vegetable and flower, special horticultural practices i.e. training, dis-budding, de-shooting, supporting and bending.

Text / Reference books

1. Greenhouse Management of Horticultural Crops by S. Prasad and U. Kumar, Kalyani Publishers.
2. Greenhouse Technology and Management by Manohar. 2006. International Book Distribution Co., Lucknow.
3. Greenhouse Environment by Mastalez, J. W. 1977. John-Wiley and Sons, New York.
4. Greenhouse Management : Forcing of Flowers, Vegetables and Fruits by Taft, L. R. 2001. Daya Publication House, New Delhi.
5. Green House Operation & Management by Nelson, 2007.
6. Green House and Shelter structure for tropical regions/FAO by Zbeltitis.
7. Protected Cultivation by A. S. Jadhav, P. V. Patil and M. T. Patil.
8. Commercial Protected Floriculture by M. T. Patil and P. V. Patil

U18PEBT041	**FOOD SAFETY AND QUALITY CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Food process engineering, Microbiology, Bioprocess Engineering, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To know about the safety regulations of food industries					
COURSE OUTCOMES (COs)					
CO1	To study the history of food safety regulations				
CO2	to know about food adulteration				
CO3	to understand about food management practices				
CO4	to get basic idea about food hygiene				

CO5	to get basic idea about microbial quality control
CO6	to get basic idea about food safety standards

UNIT I FOOD SAFETY REGULATIONS 9

History of food regulations in India- Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973),Edible Oils Packaging, 1998, Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

UNIT II FOOD SAFETY MANAGEMENT 9

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

UNIT III FOOD QUALITY MANAGEMENT 9

Principles of food quality assurance, total quality management (TQM)–good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

UNIT IV MICROBIAL CONTAMINATION 9

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry Food safety and Standards Act 2006: salient provision and prospects

UNIT V FOOD SAFETY STANDARDS 9

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarious commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

TEXT BOOKS:

1. V. K. Kaushik (1999),Nutrition And Food Safety, Neha Publishers
2. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

REFERENCE BOOKS:

1. Andre, Gordan (2015), Food Safety and Quality Systems in Developing Countries, Elsevier
2. YasmineMotarjemi(2013), Food Safety Management, 1st Edition, Elsevier

U18PEAC062	**NANOBIOTECHNOLOGY IN AGRICULTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology				

	Course Designed by – Dept of Industrial Biotechnology
OBJECTIVES: To provide basic knowledge about nanoscience involved in biotechnology	
COURSE OUTCOMES (COs)	
CO1	to understand the various nano devices
CO2	to know about nano molecules
CO3	to learn the applications of nanotechnology in proteins, lipids and nucleic acids
CO4	to know about the applications of nanotechnology in microbiology
CO5	to know about nano technology involved in drug delivery system
CO6	To understand about nanoparticles

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	G	h	I	j	k	l
2	CO1	M	M	M	H	M		H				L	M
	CO2	H	M	M	H	H		M			L		L
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H					L	L	M
	CO5	H	M	M	H	H		M				L	L
	CO6	H			H	H		M			L		M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
						√			
4	Approval	Academic Council, July 2018							

UNIT I INTRODUCTION 9

Introduction to nanobiotechnology – nanodevices& techniques – micro &nanosystems – synthesis & characterization of nanoscale molecules – nanoarchitecture – fabrication technologies – self-assembly systems

UNIT II NANODEVICES 9

Inorganic nanoscale systems – properties of fullerene carbon nano tubes – quantum dots & wires – gold nanoparticles – nanopores.

UNIT III NANOMOLECULES 9

Nanomolecules in proteins, lipids RNA & DNA – peptide coupled nanoparticles – proteins nanodevices – cell nanotechnology – cell motility – nanomotors& cellular navigation – chemotaxis – transmembranesignaling – nanoscale artificial platform.

UNIT IV MICROBIAL NANOTECHNOLOGY 9

Nanotechnology and microorganisms – PHA – magnetosomes – cyanophycin inclusions – alginates – bacteriophages – bacterial spores – S – layer proteins – bacteriorhodopsin.

UNIT V NANOMEDICINE 9

Nanotechnology in drug delivery – nanoscale devices for drug delivery – micelles – protein targeting – protein interaction with other molecule – microarray – genomic chips – nanobiosensors – nanobiochips – Nanotechnology for cancer diagnosis & treatment.

TEXT BOOK

1. K.K. Jain , 2006, "Nanotechnology in molecular diagnostics – current techniques & applications", Horizon Bioscience publishers

REFERENCE BOOKS

1. Microbial bionanotechnology:Biological Self-Assembly Systems and Biopolymer-Based Nanostructuresed: Bernd Rehm, Taylor and Francis, 2006
2. Applications of nanoparticles in biology & medicine O.V. Salata, Journal of nanobiotechnology (2004),
3. Weblink: nptel

AC003	**MARKETING AND EXPORT OF BIOTECHNOLOGICAL PRODUCTS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioorganic chemistry, Basic Biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the classification of biological databases and its role in research
CO2	to apply the concept of genomics of different organism, gene expression and mapping situations
CO3	to know the tools for gene identification and prediction
CO4	to know the structural elucidation and prediction of proteins
CO5	to get a basic knowledge of techniques related to proteomics
CO6	To know about bioinformatics tools

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M

	CO3	H	M		H	H		M	M		L	L	M
	CO4	H	M		H	H		M		M	L	L	M
	CO5	H	M	M	H	H		M	L		L	L	M
	CO6	H			H	H		M			L	L	M

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)
						√			
4	Approval	37th Meeting of Academic Council, May 2015							

UNIT I

External trade in Agricultural products, Present status, policy and prospects under WTO regime, Export import policy, Regulation of Agricultural marketing system

UNIT II

Infrastructural facilities for exporting efficiency, Biotechnological Products in India, Quality parameters and quarantine procedures of export- Market integration: Types and effects Marketing costs margins and price spread.

UNIT III

Biotech industries & institutes in India & world, Concepts of Biotech park/ Biotech Hub to different small scale and large scale Agro-based products. Study the production techniques of biotech products.

UNIT IV

Collecting the information on export import data on biotech products, quality standards for export and their potential-Analyze data in relation to demand supply.

UNIT V

Comparison between non biotechnological products and biotechnological products. Safety and licensing for import and export of biotechnological products.

Text/Reference books:

1. Agriculture Marketing in India by Acharya and Agrawal 1999, Oxford IBH, N. Delhi.

Principles of Marketing by Kotlar and Armstrong 1997, Prentice-Hall, N. Delhi.

OPEN ELECTIVES

U18OEAC001 GEO-INFORMATICS AND PRECISION FARMING 3 0 0 3

UNIT I REMOTE SENSING 9

Remote sensing: Concepts - Electromagnetic radiation: principles and theories- Energy interaction: atmosphere and earth surface features- Spectral reflectance of earth features- Platforms and sensors: types and characteristics. Image Processing and Interpretation – Digital image processing: Image Classification - Optical, Microwave and Drones

UNIT II GIS 9

GIS: Definition, Components and functions- Raster and vector data models and non-spatial data types - Raster Data Analysis: Local, Neighborhood and Regional Operations- Vector Data Analysis: Querying, Buffering, Overlay

UNIT III GLOBAL POSITIONING SYSTEM 9

Geodesy and its basic principles -Global Positioning System – components and its functions- GPS survey methods- Error sources - DEM – Sources, Generation and application.

UNIT IV PRECISION AGRICULTURE 9

Precision agriculture: concepts and techniques; their issues and concerns –STCR / VRT approach for precision agriculture - Soil moisture, Pest and Disease incidence – nutrient deficiencies – linking with VRT using Geospatial Technologies

UNIT V YIELD MONITORING 9

Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies-Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs – Drones for precision agriculture

Textbooks

1. Anji Reddy, M. 2008. Textbook of Remote Sensing and Geographic Information Systems. Third Edition. BS Publication, Hyderabad
2. Rolf A.de By. 2001. Principles of Geographic Information Systems. ITC Educational Textbook Series I
3. Roy, P.S., R.S.Dwivedi and D.Vijayan.2010. Remote Sensing Applications. NRSC Publication.

Web resources

4. www.physicalgeography.net
5. www.gisdevelopment.net
6. www.gis.nic.in
7. www.geos.iitb.ac.in/remotesensing.html
8. www.dimensionigis.com/remote_sensing.html

U18OEAC002 LIVESTOCK AND POULTRY MANAGEMENT 3 0 0 3

UNIT I INTRODUCTION TO LIVESTOCK MANAGEMENT 9

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu- Various systems of livestock production-extensive – semi intensive - intensive- mixed- Integrated and specialized farms.

UNIT II DAIRY CATTLE MANAGEMENT 9

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination – Introduction to Embryo transfer – Housing – Space requirement calf and adult stock – System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder –Total Mixed Ration **–** composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification – symptoms - preventing and control measures.

UNIT III SHEEP AND GOAT MANAGEMENT 9

Breeds - Sheep and goat classification — Economic traits - system of rearing - Housing Management – Floor space requirement - Care and Management of young and adult stock – Nutrition – Feed and fodders of Small ruminants – Flushing - Common diseases – prevention and control.

UNIT IV MANAGEMENT OF SWINE 9

Classification of breeds – Economic traits - Housing - Nutrition – creep feeding - Care and Management of Adult and Young Stock - Common disease- prevention and control.

UNIT V POULTRY MANAGEMENT 9

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers -Nutrition of Chick, grower, Layer and broiler – Incubation and Hatching of Eggs - Common Diseases - Control and prevention.

Reference:

ICAR (2002) Hand of Animal Husbandry, ICAR, New Delhi

E- reference:

1. **http://www.elearnvet.net/**
2. **http://agridr.in/expert_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html**

U18OEAC003 EXTENSION METHODOLOGIES AND TRANSFER OF AGRICULTURAL TECHNOLOGIES 30 0 3

UNIT I EXTERNAL TRADE 9

External trade in Agricultural products, Present status, policy and prospects under WTO regime, Export import policy, Regulation of Agricultural marketing system

UNIT II EXPORT PROCEDURES 9

Infrastructural facilities for exporting efficiency, Biotechnological Products in India, Quality parameters and quarantine procedures of export- Market integration: Types and effects Marketing costs margins and price spread

UNIT III BIOTECH INDUSTRIES 9

Biotech industries & institutes in India & world, Concept of Biotech park/ Biotech Hub to different small scale and large scale Agro-based products. Study the production techniques of biotech products

UNIT IV EXPORT IMPORT DATA 9

Collecting the information on export import data on biotech products, quality standards for export and their potential- Analyze data in relation to demand supply

UNIT V LICENSING FOR EMPORT AND IMPORT 9

Comparison between non biotechnological products and biotechnological products- Safety and licensing for import and export of biotechnological products

Text/Reference books:

2. Agriculture Marketing in India by Acharya and Agrawal 1999, Oxford IBH, N. Delhi.
3. Principles of Marketing by Kotlar and Armstrong 1997, Prentice-Hall, N. Delhi

U18OEAC004 SOIL AND WATER CONSERVATION ENGINEERING 3 0 0 3

UNIT I SURVEYING 9

Surveying and levelling – chain and compass – levelling – land measurement – difference in elevation.

UNIT II SOIL EROSION 9

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion – universal soil loss equation - water erosion - causes - stages of water erosion - splash, sheet, rill and gully erosion - ravines - landslides – wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

UNIT III SOIL CONSERVATION AND WATERSHED MANAGEMENT 9

Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – Rain water harvesting — Runoff computation - rational formula - water harvesting – farm ponds and percolation ponds - watershed concept – integrated approach and management

UNIT IV IRRIGATION AND DRAINAGE 9

Irrigation - measurement of flow in open channels - velocity area method - rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water - irrigation efficiencies - conveyance of irrigation water - surface irrigation methods - borders, furrows and check basins - drip and sprinkler irrigation component– agricultural drainage - surface and sub-surface drainage systems - drainage coefficient

UNIT V WELLS AND PUMPS 9

Types of wells– pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps

TEXT BOOKS

1. Basak, N.N. 2008. Surveying and Levelling. 25th reprint. Tata Mc-Graw Hill Publishing Company Ltd
2. Michael, A.M. and Ojha, T.P. 2008. Irrigation Theory and Practice. Second Edition. Vikas Publication House, New Delhi

E- REFERENCES

1. http://nptel.ac.in/courses/105107122/13
2. http://soilwater.okstate.edu/courses/lectures-powerpoint

CURRICULUM AND SYLLABUS

(R2018)
B – FACT

(Applicable to the batches admitted from July 2018)

B.Tech – BIOMEDICAL ENGINEERING
(FULL TIME)
I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics - I	4	4	0	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	0
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
Total				31	14	0	17	22.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics II	4	4	0	0	4
3	U18BSPH202	BS	Semi-Conductor Physics	3	3	0	0	3
4	U18BSCH201	MC	Environmental Sciences	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi-Conductor Physics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	34	16	1	12	23.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
S. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA301	BS	Transforms and Partial Differential Equation	4	3	1	0	4
2	U18PCBM301	PC	Anatomy and Physiology	3	3	0	0	3
3	U18PCBM302	PC	Analog and Digital Integrated Circuits	3	3	0	0	3
4	U18PCBM303	PC	Microprocessor and Microcontrollers in Biomedical Applications	3	3	0	0	3
5	U18PCBM304	PC	Electronic Devices and Circuits	3	3	0	0	3
6	U18PCBM305	PC	Biosensors and Measurements	3	3	0	0	3
PRACTICAL								
7	U18PCBM3L1	PC	Anatomy and Physiology Lab	2	0	0	2	1
8	U18PCBM3L2	PC	Microprocessors and Microcontrollers lab	2	0	0	2	1
9	U18PCBM3L3	PC	Biosensors and Measurements lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	**29**	**16**	**1**	**10**	**22**

SEMESTER IV								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA402	BS	Probability Statistics And Numerical Methods	4	3	1	0	4
2	U18PCBM401	PC	Medical Instrumentation I	3	3	0	0	3
3	U18PCBM402	PC	Fundamentals of Biochemistry	3	3	0	0	3
4	U18PCBM403	PC	Medical Physics	3	3	0	0	3
5	U18PCBM404	PC	Analog and Digital Communication System	3	3	0	0	3
6	U18PCBM405	PC	Biomaterials and Artificial Organs	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
7	U18PCBM4L1	PC	Biochemistry Lab	2	0	0	2	1
8	U18PCBM4L2	PC	Analog and Digital Communication System Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	**28**	**19**	**1**	**8**	**21**

SEMESTER V								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBM501	PC	Bio Control System	3	3	0	0	3
2	U18PCBM502	PC	Medical Instrumentation - II	3	3	0	0	3
3	U18PCBM503	PC	Digital Signal Processing for Bio Engineers	3	3	0	0	3
4	U18HSBA401	HS	Organizational Behaviour	3	3	0	0	3
5		PE	Professional Elective –I	3	3	0	0	3
7		OE	Open Elective I	3	3	0	0	3
6	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
7	U18PCBM5L1	PC	Medical Instrumentation lab	2	0	0	2	1
8	U18PCBM5L2	PC	Digital Signal Processing for Bio Engineers lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	**28**	**20**	**0**	**8**	**20**

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBM601	PC	Pathology and Microbiology	3	3	0	0	3
2	U18PCBM602	PC	Diagnostic and Therapeutic Equipment	3	3	0	0	3
3	U18PCBM603	PC	Radiological Equipments	3	3	0	0	3
4	U18PCBM604	PC	Telemedicine	2	2	0	0	2
5.		PE	Professional Elective II	3	3	0	0	3
6		OE	Open Elective II	3	3	0	0	3
PRACTICAL								
7	U18PCBM6L1	PC	Pathology and microbiology Lab	2	0	0	2	1
8	U18PCBM6L2	PC	Virtual Modelling Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB611	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB612	MC	Self-Development - religion and Inter-faith	2	0	0	2	0
			Total	**25**	**17**	**0**	**8**	**19**

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBM701	PC	Digital and Medical Image Processing	3	3	0	0	3
2	U18PCBM702	PC	Robotics and Nanotechnology in Medicine	3	3	0	0	3
3	U18PCBM703	PC	Health, Hospital & Equipment Management	3	3	0	0	3
4		PE	Professional Elective III	3	3	0	0	3
5.		PE	Professional Elective IV	3	3	0	0	3
6		OE	Open Elective III	3	3	0	0	3
7	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
7	U18PCBM7L1	PC	Image Processing Lab	2	0	0	2	1
8	U18EEBM7L2	EE	Inplant Training in Hospital	2	0	0	1	1
9	U18EEBM7P1	EE	Project Phase I	6	0	0	6	3
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioural and interpersonal skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	**32**	**20**	**0**	**13**	**23**

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective V	3	3	0	0	3
2		PE	Professional Elective VI	3	3	0	0	3
3		OE	Open Elective IV	2	2	0	0	2
PRACTICAL								
7	U18EEBM8P2	EE	Project Phase II	18	0	0	18	9
8	U18EEBM8C1	EE	Comprehension	0	0	0	0	1
ACTIVITY BASED COURSES								
10	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	**28**	**8**	**0**	**18**	**18**

Total No. of Credit: 169 **Total Contact Hour: 235**

LIST OF ELECTIVES PROFESSIONAL ELECTIVE

SUBJECT CODE	SPECIALIZATION	SUBJECT NAME	Contact Periods	L	T	P	C
PROFESSIONAL ELECTIVE (PE) - I							
U18PEBM011	Anatomy and Physiology	Biofluids and Biomechanics	3	3	0	0	3
U18PEBM012	Medical Instrumentation I	Human Assist Devices	3	3	0	0	3
U18PEBM013	Computer Programming	Medical Informatics	3	3	0	0	3
PROFESSIONAL ELECTIVE (PE) –II							
U18PEBM021	Electronic Devices and Circuits	Troubleshooting of Medical Instruments	3	3	0	0	3
U18PEBM022	Microprocessor and DSP	Real Time Processor and Bio MEMS	3	3	0	0	3
U18PEBM023	Hospital Management	Clinical Engineering	3	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - III							
U18PEBM031	Radiological Equipments	Nuclear Medicine	3	3	0	0	3
U18PEBM032	Bio control systems	Modelling of Physiological Systems	3	3	0	0	3
U18PEBM033	Biomaterials	Tissue Engineering	3	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - IV							
U18PEBM041	Image Processing	Neural Network and Pattern Recognition	3	3	0	0	3
U18PEBM042	Artificial Organs	Rehabilitation Engineering	3	3	0	0	3
U18PEBM043	Medical Instrumentation	Brain Control Interface	3	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - V							
U18PEBM051	Biochemistry	Bioprocess Technology	3	3	0	0	3
U18PEBM052	Digital systems	VLSI Design	3	3	0	0	3
U18PEBM053	Medical Instrumentation	Virtual Instrumentation	3	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - VI							
U18PEBM061	Radiological Equipments	Biological Effects of Radiation	3	3	0	0	3
U18PEBM062	Medical Physics	Biomedical laser Instrumentation	3	3	0	0	3
U18PEBM063	Physics	Bio-photonics	3	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial

45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS004-Mobile Application Development
72. U18OECS005-System Modelling and Simulation
73. U18OECS006-Web Programming
74. U18OECS007-Virtual Reality
75. U18OECS008- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	2	1	1	0	2
3	U18HSBA401	HS	Organisational Behavior	3	3	0	0	3
TOTAL CREDITS								8

BASIC SCIENCE COURSES (BS)

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
THEORY								
1	U18BSMA101	BS	Engineering Mathematics - I	4	4	0	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
5	U18BSMA201	BS	Engineering Mathematics II	4	4	0	0	4
6	U18BSPH202	BS	Semi-Conductor Physics	3	3	0	0	3
7	U18BSMA301	BS	Transforms and Partial Differential Equation and	4	3	1	0	4
8	U18BSMA402	BS	Probability Statistics And Numerical Methods	4	3	1	0	4
PRACTICAL								
11	*U18BSPH2L2	BS	Wave Optics and Semi-Conductor Physics Lab	3	0	0	3	1.5
12	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
TOTAL CREDITS								30

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
THEORY								
1	U18ESEE101	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	3
2	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3

3	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
4	U18LCME101	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
5	U18LCEE101	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
6	U18LCCS101	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
TOTAL CREDITS								15

PROFESSIONAL CORE COURSES

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCBM301	PC	Anatomy and Physiology	3	3	0	0	3
2	U18PCBM302	PC	Analog and Digital Integrated Circuits	3	3	0	0	3
3	U18PCBM303	PC	Microprocessor and Microcontrollers in Biomedical Applications	3	3	0	0	3
4	U18PCBM304	PC	Electronic Devices and Circuits	3	3	0	0	3
5	U18PCBM305	PC	Biosensors and Measurements	3	3	0	0	3
6	U18PCBM401	PC	Medical Instrumentation I	3	3	0	0	3
7	U18PCBM402	PC	Fundamentals of Biochemistry	3	3	0	0	3
8	U18PCBM403	PC	Medical Physics	3	3	0	0	3
9	U18PCBM404	PC	Analog and Digital Communication System	3	3	0	0	3
10	U18PCBM405	PC	Biomaterials and Artificial Organs	3	3	0	0	3
11	U18PCBM501	PC	Bio Control System	3	3	0	0	3
12	U18PCBM502	PC	Medical Instrumentation - II	3	3	0	0	3
13	U18PCBM503	PC	Digital Signal Processing for Bio Engineers	3	3	0	0	3
14	U18PCBM601	PC	Pathology and Microbiology	3	3	0	0	3

15	U18PCBM602	PC	Diagnostic and Therapeutic Equipment	3	3	0	0	3
16	U18PCBM603	PC	Radiological Equipments	3	3	0	0	3
17	U18PCBM604	PC	Telemedicine	2	3	0	0	2
18	U18PCBM701	PC	Digital and Medical Image Processing	3	3	0	0	3
19	U18PCBM702	PC	Robotics and Nanotechnology in Medicine	3	3	0	0	3
20	U18PCBM703	PC	Health, Hospital & Equipment Management	3	3	0	0	3
PRACTICAL								
21	U18PCBM3L1	PC	Anatomy and Physiology Lab	2	0	0	2	1
22	U18PCBM3L2	PC	Microprocessors and Microcontrollers lab	2	0	0	2	1
23	U18PCBM3L3	PC	Biosensors and Measurements lab	2	0	0	2	1
24	U18PCBM4L1	PC	Biochemistry Lab	2	0	0	2	1
25	U18PCBM4L2	PC	Analog and Digital Communication System Lab	2	0	0	2	1
26	U18PCBM5L1	PC	Medical Instrumentation lab	2	0	0	2	1
27	U18PCBM5L2	PC	Digital Signal Processing for Bio Engineers lab	2	0	0	2	1
28	U18PCBM6L1	PC	Pathology and microbiology Lab	2	0	0	2	1
29	U18PCBM6L2	PC	Virtual Modelling Lab	2	0	0	2	1
30	U18PCBM7L1	PC	Image Processing Lab	2	0	0	2	1
TOTAL CREDITS								69

MANDATORY COURSES (MC)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18MCTH401	MC	Constitution of India	2	2	0	0	0
2	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
3	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
ACTIVITY BASED COURSES								
1	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
2	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	18MCAB201	MC	Yoga	2	0	0	2	0
4	18MCAB202	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB301	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB302	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
7	U18MCAB401	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
8	U18MCAB402	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
9	U18MCAB501	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB502	MC	Social Services – NSS	2	0	0	2	0
11	U18MCAB601	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB602	MC	Self-Development - religion and Inter-faith	2	0	0	2	0
13	U18MCAB701	MC	Behavioural and interpersonal skills	2	0	0	2	0
14	U18MCAB702	MC	Nature – Nature club	2	0	0	2	0
15	U18MCAB801	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL CONTACT PERIODS = 36								

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences (HS)	3	3			3				9	5.33
2	Basic Sciences (BS)	12	13	4	4					33	19.52
3	Engineering Sciences (ES)	7.5	7.5							15	8.87
4	Professional Core (PC)			18	17	11	13	10		69	40.83
5	Professional Electives(PE)					3	3	6	6	18	10.65
6	Open Electives (OE)					3	3	3	2	11	6.51
7	Employability Enhancement Courses(EE)Project Work, Soft Skill etc.							4	10	14	8.28
	Total Credit	22.5	23.5	22	21	20	19	23	18	**169**	100
	Total Contact Hour	31	34	29	28	28	25	32	28	**235**	

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	2	0	2	3
	Prerequisite – School English				
	Dept Designed by: epartment of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6 hours

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing one self – exchanging personal information- narrating events, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6 hours

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -The concept of Word Formation

UNIT III LISTENING 6 hours

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6hours

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development-synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6 hours

Writing short essays – developing an outline- identifying main and subordinate ideas-dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures-Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely.

SOFTSKILL LABORATORY **30hours**

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds- intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES (COs)	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1				**M**			**H**		**M**					
	CO2				**M**			**H**		**M**					
	CO3				**M**			**H**		**M**			**H**		
	CO4				**M**			**H**		**M**			**M**		

	CO5				**M**			**H**		**M**			**H**		
3	Category	Humanities and Social Studies (HS)													
4	Approval	47th Meeting of Academic Council													

U18BSMA101	**ENGINEERING MATHEMATICS – I**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	4	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	➢ To familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. ➢ To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H				M		L			L		
	CO2	H		H	W	M			M				
	CO3	H				M				L			
	CO4	H	M			M				L			
	CO5	H		H		M				M	L		
3	Category	Basic Science (BS)											
4	Approval	47th Meeting of Academic Council											

U18BSPH101	**WAVES AND OPTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION **9**

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – etection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2. G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1. BrijLal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2. R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3. BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4. Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5. H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6. Ajoy Ghatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7. O. Svelto, "Principles of Lasers", Springer, 2010
8. Online reference Wikipedia.org

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H	H	M	H	M			M	H	H		H
	CO2	L	H	M	M	H			M		L	H	L
	CO3	H	L			L			M	M		M	H
	CO4	H	L			L			M	M		M	H
	CO5	H	M	M	M				M		H	W	H
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council											

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS **9**

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS **9**

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane

number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. Nanocomposites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M		H		H		L		H
	CO2		L	H		M		S		M		L	
	CO3		M		H		L				M		
	CO4	H		M	H			M			H		H
	CO5		H		L		M				H		
3	Category	Basic Science (BS)											
4	Approval	47th Meeting of Academic Council											

U18ESEE101	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2011.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition, 2015.
6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	L			M				H		W	H
	CO2	H	L			M				H		W	H
	CO3	H	M			M				H		W	H
	CO4	H	L			M				H		W	H
	CO5	H	L			M				H		W	H
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level in Physical & Life Sciences signaling				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector					

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation- nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)													
The student will be able													
CO1	To understand the basic concepts of the cell and its structure												
CO2	To understand about biodiversity and its conservation												
CO3	To know the fundamentals of genetics and the immune system												
CO4	To create an awareness about human diseases												
CO5	To give a basic knowledge of the applications of transgenic												
Mapping of Course Outcomes with Program Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M	M			H	M	H
	CO2	H			M		H		M	M			H
	CO3	M		M			M						M
	CO4							H			M	M	
	CO5	H	H					H	M	M			H
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council											

U18BSPH2L2	WAVE OPTICS AND SEMI-CONDUCTOR PHYSICS LABORATORY	L	T	P	C
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart knowledge of practical Physics to the students

Course Outcome (CO's)

The student will be able

CO1	Understand the fundamental concept of optics
CO2	Understand the concept of production of ultrasonic waves
CO3	Understand the functions of semiconductor

Mapping of Course Outcomes with Programme Outcomes (POs)
S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H	H				H	L	M		
	CO2	H	H	L					H	L	M		
	CO3	L	H	H					H	L	M		
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Semiconductor Physics – Circuit branches

1) Determination of Band Gap
2) Zener diode characteristics
3) p-n junction diode Characteristics
3) Transistor Characteristics
5) V-I characteristics using LDR circuit
6) Carey Foster's Bridge

U18BSCH2L4	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				

OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry

3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	M		H		H		L		H
	CO2	W	H			M		H		M		L	L
	CO3		M		M						M		
	CO4	H		M				M				H	H
	CO5		H		L		M				H		
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council											

U18ESME1L2	**WORKSHOP/MANUFACTURING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fitting models.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**

Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

6. Demonstration **(6 Hours)**

Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
2. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
4. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											H	
	CO2			H	M							H	
	CO3		M										
	CO4	H			L							H	H
	CO5											H	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H				H		M	H
	CO2	H	H			H				H		M	H
	CO3	H	H			H				H		M	H
	CO4	H	H			H				H		M	H
	CO5	H	H			H				H		M	H
	CO6	H	H			H				H		M	H
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

UNIT I LISTENING **9**

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)	
The student will be able	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		
	CO4	L		M	L			M				M	H

	CO5		H		L		M				H		
3	Category	Humanities and Social Studies (HS)											
4	Approval	47th Meeting of Academic Council											

U18BSMA201	**ENGINEERING MATHEMATICS II**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objectives of this course are to equip the students of Engineering and Technology with techniques in ➢ Ordinary equations, vector calculus, complex variables. ➢ Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		
	CO4	L		M	L			M				M	H
	CO5		H		L		M				H		
3	Category	Basic Science (BS)											
4	Approval	47th Meeting of Academic Council											

U18BSPH202	**SEMICONDUCTOR PHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES

- To develop physics and engineering strategies of semiconductor materials and to discuss their functionalities in modern electronic and optoelectronic devices

UNIT 1 INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS 9

Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential:Kronig - penny and nearly free electron models - Real methods for band structure calculations; Band gaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands

UNIT 2 CARRIERS AND DOPING 9

Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration – intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Band gap engineering

UNIT 3 ELECTRICAL TRANSSORT 9

Scattering Mechanism: electron - electron and electron – phonon scattering. Macroscopic transport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field and very high field.

UNIT 4 OPTICAL TRANSSORT 9

Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties. Carrier transport - continuity equations. Optical constants: Kramers - Kronig relations.

UNIT 5 SEMICONDUCTOR AS DEVICES AND RECENT ADVANCES 9

Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductor junctions - Homo and hetero Junctions. Active and passive optoelectronic devices: performance and response enhancement (photo processes)**.**

TEXT BOOK:

1. M.N. Avadhanulu and P.G. Kshirsagar, “A Textbook of Engineering Physics” S.Chand Publishers, 2014 **(for units 1 and 2)**

2. G.Senthil Kumar, “Engineering Physics”, VRB publishers, Chennai, 2015 (for Unit 5)

REFERENCES BOOKS:

1. Kevin F Brennan, "The Physics of Semiconductors", Cambridge Univ.Press 1999.
2. Peter Y Yu and Manuel Cardona, "Fundamentals of Semiconductors",Spriger, 1996.
3. Charles Kittel, "Introduction to Solid State Physics", 6th edition, Willey, 1991.
4. D.A. Neamen, "Semiconductor Physics and Devices", 3 rdEd.,Tata McGraw-Hill,2002.
5. Jasprit Singh, "Semiconductor Optoelectronics (Physics and Technology)", McGraw-Hill, 1995.
6. Online reference: Wikipedia, NPTEL

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the difference between metals, semiconductors and insulators
CO2	Understand the importance of doping to charge carrier density
CO3	Understand the electrical transport in semiconductors
CO4	Understand the difference between direct and indirect semiconductors
CO5	Understand the concept of semiconductor optoelectronic devices.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		

	CO4	L		M	L			M				M	H
	CO5		H		L		M				H		
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION **9**

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION **9**

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION **9**

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
The student will be able to	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes
Mapping of Course Outcomes with Program Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	L			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		
	CO4	L		M	L			M				M	H
	CO5		H		L		M				H		
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING **9**

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python– Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
The student will be able to	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	Gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	Ggain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	H	M	H	M	L		M	L	M	H
	CO2	H	H	M	M		M		L			M	H
	CO3	M	M	L	H	M		L		L		M	M
	CO4	M	M	L	M	S	M	L	M	L		M	M
	CO5	M	S	W	M	M			M	M	L		M
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

U18ESME101	**ENGINEERING GRAPHICS&DESIGN(Theory&Lab)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice

SYLLABUS

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4: SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M			H					H
	CO2	H	H	L		H	M						H
	CO3			H									
	CO4											H	
	CO5	H						L					H
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Maths and Physical Science				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab,NumPy and Matplotlib

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M	H	H	M	M	M	M		M	H
	CO2	H	H	L	H	H	M	L	M	M	M	M	H
	CO3	H	H	M	M	M	M		M	M	M	M	H
	CO4	H	M	H	H	H	M	M	M	M	L		H
	CO5	H	H	M	S	M	M		M	M	L	M	H
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council											

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.„ 2015.

PLATFORM NEEDED

1. Python 3 interpreter for Windows/Linux and Scilab

U18BSMA301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course – Engineering Mathematics-II				
	Course Designed by:- Department of Mathematics				

COURSE OBJECTIVES:-

- Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.
- Learn techniques of solving the standard types of first order and second order partial differential equations.
- Learn solving wave and heat equation using Fourier series.
- Understand the problems using Fourier transform and their properties. Understand the problems using Z - transform and their properties

UNIT I FOURIER SERIES (9+3)

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Classifications second order linear partial differential equations – Solution of one-dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM (9+3)

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS (9+3)

Z – Transform – Elementary properties – Inverse Z – Transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – Transform.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.

COURSE OUTCOMES	
CO1	To Solve PDE and higher order with constant coefficients and physically interpret the results.
CO2	To Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer July have to make from discrete data.
CO3	To Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	To Solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications.
CO5	To Apply the basics of Z – Transform in its applicability to discretely varying functions.
CO6	To Gain the skill of formulate certain problems in terms of difference equations and solve them using the Z – Transform techniques.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\POs	1	2	3	4	5	6	7	8	9	10	11	12	PS01	PS02
1	3	2		3	3			3	3	3	3			3
2	3	3	3	3	3			3	3	3	3			
3	3	3	3	3	3			3	3	3	3			
4	3	3	3	3	3			2	3	3	3			
5	3	3	3	3	3			3	3	3	3			
6	3	3	3	3	3			3	3	3	3			
Category	Professional Core (PC)													
Approval	47th Meeting of Academic Council													

U18PCBM301	ANATOMY AND PHYSIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biology for Engineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To recall the basic terminologies, cells, tissues and organs of human body.
- To explain about the positioning and functioning of the various organ systems.
- To differentiate the relation between the various physiological processes.
- To outline the various sense organs and relate the functions of hormones with physiological process.

UNIT I BASIC ELEMENTS OF HUMAN BODY 9

Anatomical terms of Location, Position and Planes. Structure and functions of Cell and organelles. Tissues of the human body: epithelial, connective, muscular and nervous tissues. Overview of organ systems. Membrane-Transport across membrane, Origin of cell membrane potential, Action potential. Blood-Properties and functions, Cellular Components: RBC, WBC, platelets, Blood Groups.

UNIT II CARDIOVASCULAR AND RESPIRATORY SYSTEMS 9

Structure of heart, Blood vessels, Conduction system of heart, Physiology of Cardiac Muscle, Cardiac cycle, Heart Sound, Cardiac output – Coronary and Peripheral Circulation, Blood pressure and its regulation. Respiratory Organs, Mechanism of respiration, Carbon dioxide and oxygen transport, Regulation of respiration, Volumes and capacities of lung.

UNIT III NERVOUS SYSTEM AND MUSCULOSKELETAL SYSTEM: 9

Neurons, Synapse and neurotransmitters, Central nervous system: Structure and functions of brain, Meninges, ventricles of brain and cerebrospinal fluid, Spinal cord anatomy. Peripheral nervous system: Classification of peripheral nervous system, Autonomic nervous system, Reflex action. Muscular System: Classification of muscles, Anatomy and Physiology of skeletal muscle. Bone: Types, Functions, Anatomy of long bone – Formation, growth and repair, Structural and functional classification of joints.

UNIT IV DIGESTIVE AND EXCRETORY SYSTEM 9

Anatomy of the gastro-intestinal tract, Accessory organs of Digestion - Salivary glands, Liver, Pancreas, Gall Bladder. Movement of gastrointestinal tract, Digestion and absorption at various parts of the system, Defecation. Anatomy of Urinary System, Physiology of urine formation, physiology of micturition, Composition of Urine. Skin and Sweat Gland – Temperature regulation.

UNIT V SPECIAL ORGANS AND ENDOCRINE GLANDS 9

Anatomy of Eye and Physiology of Vision, Structure of Ear and Physiology of Hearing, Sense of Smell, Sense of Taste. **Endocrine system:** Structure and functions of Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas, Pineal gland, Thymus, Ovaries and Testes.

TEXT BOOKS:

1. Arthur C. Guyton, John E. Hall, "Textbook of Medical Physiology", W.B. Saunders Company, Twelfth Edition, 2006.
2. Stuart I. Fox, "Human Physiology", Tata McGraw Hill, 9th Edition,2006.

REFERENCES:

1. Ross & Wilson, "Anatomy & Physiology for Health and Illness", Elsevier, 11thEdition,2010.
2. Ranganathan, T.S. "Text Book of Human Anatomy", S.Chand & Co. Ltd., Delhi,1996.

COURSE OUTCOMES (COs)															
CO1	To Define the basic terminologies and outline the different tissues and organ systems.														
CO2	To Describe the various organ systems and their functions														
CO3	To Illustrate the cardiovascular, respiratory, digestive, excretory and other organ systems														
CO4	To Explain the nervous and musculoskeletol system														
CO5	To Compare and identify the relation between cardiovascular and respiratory, digestive and excretory system.														
CO6	To Demonstrate the special organs and functions of endocrine glands														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**

2	CO1	2				3	2	3			1	2			
	CO2	2	3	2	3	3	2				1	2			
	CO3			2				3			1	2			
	CO4	2	3	2	3	3	2				1	2			
	CO5	2		2			2	3				2			
	CO6	2				3	2	3			1	2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM302	**ANALOG AND DIGITAL INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand the number systems and their conversions, Boolean expressions, Boolean postulates and Karnaugh map method.
- To impart the design knowledge of various combinational logic circuits and sequential circuits.
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits.
- To get familiarized with operational amplifiers and its characteristics design and the working of waveform generators, regulators, filters and timers circuits.
- To design and the working of waveform generators, regulators, filters and timers circuits

UNIT I NUMBER SYSTEMS AND LOGIC GATES 9

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems- 1's and 2's complements - subtraction using complements – Encoding numbers and characters using Binary digits. –Binary coded Decimal –Gray code - Binary to Gray code conversion –ASCII Code. Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions, Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders.

UNIT II REGISTERS AND COUNTERS 9

Flip Flops – RS, D, T, JK Flip Flops – Characteristic equations, exciting tables – JK Master – Slave flip-flop – Universal shift register, ripple counters, synchronous counters.

UNIT III OPERATIONAL AMPLIFIERS 9

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth - equivalent circuit of an op-Amp – virtual ground concept – inverting and noninverting amplifier, adder, Subtracter, Instrumentation Amplifier, voltage to current converter – current to voltage converter — differentiator and integrator.

UNIT IV ACTIVE FILTERS AND SIGNAL GENERATOR 9

Active filters (first and second order) – Low pass, high pass, band pass filters, band reject filters (notch filters), Oscillators - RC Phase shift and Wein-bridge, Waveform generators - Triangular and Saw tooth.

UNIT V TIMER, PLL, A/D AND D/A CONVERTERS 9

555 Timer-Functional Block Diagram) – monostable multivibrator, astable multivibrator. Phase locked Loop (565 - block diagram approach), DAC – Binary weighted DAC and R-2R DAC, ADC – single slope and dual slope ADCs, successive approximation ADC.

TEXT BOOK:

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.

REFERENCES:

1. John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.
5. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.

COURSE OUTCOMES (COs)															
CO1	To define the principles of Boolean algebra to manipulate and minimize logic Expressions														
CO2	To Design various sequential circuits using flip flops (counters, shift registers, etc.,)														
CO3	To illustrate the Operational Amplifier with its characteristics														
CO4	To outline the functions of filters and waveform generators														
CO5	To relate the concepts of PLL and its applications														
CO6	To extend the knowledge in the operation of ADC,DAC and its applications														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	2	3	2	3		2	3	2		1	2	2		
	CO2		3	2	3	3	2	3			1	2			
	CO3	2	3	2	3	3	2	3	1		1	2	1		
	CO4	2	3		3	3		3			1				
	CO5		3		3	3	2	3		2	1	2			
	CO6	2	3	2	3		2	3	2		1	2	2		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM303	**MICROPROCESSOR AND MICROCONTROLLERS IN BIOMEDICAL APPLICATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the architecture of 8086 and 8051
- To study the addressing modes and instruction set of 8086 and 8051
- To introduce the need and use of interrupt structure in 8086 8051.
- To develop skill in simple program writing for 8086 and 8051 applications.
- To introduce commonly used peripheral / interfacing ICs.

UNIT I: OVERVIEW OF 8086 MICROPROCESSOR 9

Evolution of Microprocessor and its importance in biomedical domain, Architecture and signal description of 8086, Minimum and maximum mode, addressing modes, Instruction set

UNIT II: 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure

UNITIII: 8051 Microcontroller 9

Introduction to 8 bit microcontroller, signal descriptions of 8051- Architecture of 8051 - Register set of 8051 - Instruction set - Addressing mode

UNITIV: I/O INTERFACING 9

Timer-serial communication-interrupts programming - Interfacing to external memory - Basic techniques for reading & writing from I/O port pins - Interfacing 8051 to ADC - Liquid crystal display (LCD), keyboard - Stepper motor

UNIT V: 8086 APPLICATIONS AND OVERVIEW OF HIGHER PROCESSORS 9

8086 applications-stepper motor speed control- keyboard and display interfacing-introduction to PIC processor- Design of pulse oximeter circuit using ARM microcontroller

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085".Sixth edition, Penram International Publishing 2012.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware". Revised Second Edition 2006, eleventh reprint 2010.Tata McGraw Hill.

REFERENCES:

1. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education 2008.Fifth impression 2011.
2. Krishna Kant, ― Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096, PHI, 2007, Seventh Reprint, 2011.
3. Kenneth J. Ayala., ―The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning, 2012.
4. A.K. Ray, K.M. Bhurchandi, ―Advanced Microprocessor and Peripherals‖, Second edition, Tata McGraw-Hill, 2010. 5. Barry B. Brey, ―The Intel Microprocessors Architecture, Programming and Interfacing‖, Pearson Education, 2007. Second impression 2010.

COURSE OUTCOMES (COs)	
CO1	To define the basics of microprocessor
CO2	To label the different addressing modes
CO3	To design and develop microprocessor architecture.
CO4	To develop microprocessor and microcontroller systems for entertainment, communication and medical applications.
CO5	To demonstrate the troubleshooting of microprocessor and microcontroller systems.
CO6	To recall the basics of microcontroller systems and its applications

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1			3		2		3	1	1	2	2		3	
	CO2	3	2		3					1	2	2	1		
	CO3			3	3	2		1	3	1	2				
	CO4	3					3			1	2				
	CO5	3	2	3	3	2	3		3	1	2	2			
	CO6			3		2		3	1	1	2	2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM304	**ELECTRONIC DEVICES AND CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES **9**

Intrinsic and Extrinsic semiconductor - PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Display devices- LED, Laser diodes, Zener diode-characteristics.

UNIT II TRANSISTORS **9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS **9**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response

UNIT IV RECTIFIERS **9**

Half and full wave, ripple factor calculations for C, L, L-C.

UNIT V POWER SUPPLIES **9**

SMPS, linear electronic voltage regulators, power control using SCR. voltage controlled oscillators and phase locked loop

TEXT BOOKS:

1. David A. Bell ,‖Electronic devices and circuits‖, Oxford University higher education, 5th edition 2008. 2. Sedra and smith, ―Microelectronic circuits‖,7th Ed., Oxford University Press

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, ―Electronic devices and circuits‖ PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, ―Electronic devices‖ Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, ―Electronic Circuit Analysis and Design‖ Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, ―Electronic Devices and Circuit Theory‖, 2002.
5. Robert B. Northrop, ―Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation‖, CRC Press, 2004.

COURSE OUTCOMES (COs)	
CO1	To Explain the structure and working operation of basic electronic devices.
CO2	To classify and differentiate both active and passive elements
CO3	To outline the characteristics of different electronic devices such as diodes and transistors
CO4	To Choose and adapt the required components to construct an amplifier circuit.
CO5	To apply the acquired knowledge in design and analysis of oscillators
CO6	To define basics of power supply's and its applications

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3	2	3				1			3	1	3	
	CO2		3	2	3	3		3			1	3			
	CO3	2					2	3		3	1	3			
	CO4		3	2	3	3			2				3		
	CO5		3		3	3	2	3			1	3			
	CO6	3	3	2	3				1			3	1		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM305	**BIOSENSORS AND MEASUREMENTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To know the different display and recording devices.

UNIT I SCIENCE OF MEASUREMENT 9

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II TYPES OF TRANSDUCERS 9

Resistive Transducers - Potentiometer, Strain Gauge, Thermometer, Thermocouple, Inductive transducer – LVDT, Capacitive Transducer - Displacement & Pressure transducers, Piezoelectric transducer , Biomedical applications.

UNIT III PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS 9

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer

UNIT IV SIGNAL CONDITIONING & SIGNAL PROCESSOR 9

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.

UNIT V BIOSENSORS APPLICATIONS 9

Biosensors - Working Principle and Types. Chemical Biosensor-ISFET, IMFET, electrochemical sensor, chemical fibro sensors. Bananatrode, Blood glucose sensors, UREASE Biosensor Applications.

TEXT BOOKS:

1. L.A Geddes and L.E.Baker , _Principles of Applied Biomedical Instrumentation‘ Third Edition, – John Wiley and sons, Reprint 2008.
2. Albert D.Helfrick and William D.Cooper.―Modern Electronic Instrumentation and Measurement Techniques‖, Prentice Hall of India, 2007.

REFERENCES:

1. A.K.Sawhney,―Electrical & Electronics Measurement and Instrumentation‖,10th Edition, Dhanpat Rai & Co, New Delhi,2000.
2. Ernest o Doebelin and dhanesh N manik, Measuremet systems, Application and design, 5th Edition, McGraw-Hill, 2007.
3. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.

4. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, ―Biomedical Instrumentation and Measurement‖, Prentice Hall India Pvt. Ltd. , New Delhi, 2nd Edition, Reprint, 2013.
5 John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 2009.

COURSE OUTCOMES (COs)	
CO1	To define the purpose and methods of measurements
CO2	To outline the characteristics of different sensor
CO3	To Interpret the characteristics of different transducers
CO4	To list different Piezo electric sensors
CO5	To classify different signal conditioners
CO6	To recall basics applications of the biosensors

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3	2	3	3	2	3			1	3		3	
	CO2	3		2	3				1		1		2		
	CO3							2		1		3			
	CO4	3	3	2	3	3	2	3		2			1		
	CO5	3	3		3			3			1	3			
	CO6	3	3	2	3	3	2	3			1	3			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM3L1	**ANATOMY AND PHYSIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	1
	Prerequisite course – Biology for Engineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To Provide exposure to the fundamentals of human anatomy and physiology.
- To Analyse the methods for measurement of blood pressure and ECG.
- To learn the methods for identification and estimation of blood components.

LIST OF EXPERIMENTS

1. Study on Upper Extremity of bone.
2. Study on Lower Extremity of bone
3. Study of ECG.
4. Study of Microscope
5. Study of Haemocytometer
6. Blood Pressure Monitoring.
7. RBC Count
8. WBC Count
9. Differential count of WBC'
10. Hemoglobin Estimation.

11. ESR Estimation.
12. Blood group identification
13. Separation of Plasma and Serum
14. Determination of CT and BT

COURSE OUTCOMES (COs)	
CO1	To outline the bonesof upper and lower extremities
CO2	To Explain the working principle of Electrocardiogram
CO3	To Analyze the Total count of blood and Hemoglobin Estimation.
CO4	To Analyze the process of Blood Pressure Monitoring
CO5	To outline the haemocytometer and microscope
CO6	To identify the different Types of Blood groups.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	2	3		3	3	2	3		3	1	M	M		3
	CO2		3						3						
	CO3		3	2			2	3		1	1	3			
	CO4	2									1		2		
	CO5	2	3	2	3	3	2	3		2		2	2		
	CO6	2	3		3	3	2	3		3	1	2	2		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM3L2	**MICROPROCESSORS AND MICROCONTROLLERS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	1
	Prerequisite course – – Basic Electrical and Electronics Engineering Practices Laboratory				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Study the Architecture of 8086 microprocessor
- Learn the design aspects of I/O and Memory Interfacing circuits
- Study about communication and bus interfacing
- Study the Architecture of 8051 microcontroller

LIST OF EXPERIMENTS:

1. Familiarization of 8086 microprocessor kit.
2. Familiarization of 8051 microcontroller kit
3. 8086 assembly language programming exercises
4. 8051 assembly language programming exercises
5. Interfacing of switches and display devices
6. Interfacing of D/A convertors
7. Interfacing of A/D converters
8. Interface of key board and display using programming controllers
9. Interface of programmable timer
10. Stepper motor control using microprocessor

COURSE OUTCOMES (COs)															
CO1	To explain 8086 microprocessor														
CO2	To Design and implement programs on 8086 microprocessor														
CO3	To Demonstrate Memory Interfacing circuits.														
CO4	To Design and implement 8051 microcontroller based systems.														
CO5	To infer the instruction sets and interfacing														
CO6	To Demonstrate the instruction sets and programming for microprocessor														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	2	3		3	3	2	3		3	1	M	M		3
	CO2		3						3						
	CO3		3	2			2	3		1	1	3			
	CO4	2									1		2		
	CO5	2	3	2	3	3	2	3		2		2	2		
	CO6	2	3		3	3	2	3		3	1	2	2		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM3L3	**BIOSENSORS AND MEASUREMENTS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	1
	Prerequisite course – – Basic Electrical and Electronics Engineering Practices Laboratory				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.
- Know the different display and recording devices.

LIST OF EXPERIMENTS:

1. Characteristics of Strain Gauge
2. Characteristics of LVDT.
3. Characteristics of LDR
4. Characteristics of Thermistor.
5. Characteristics of Potentiometric Transducer.
6. Characteristics of Photodiode.
7. Characteristics of Load cell
8. Characteristics of Phototransistor.
9. Study of Multimeter.
10. Study of Digital tachometer.

COURSE OUTCOMES (COs)	
CO1	To Analyze the characteristics of different sensor
CO2	To Analyze the characteristics of Potentiometric Transducer

CO3	To Analyze the characteristics of thermistor
CO4	To Analyze the characteristics of LVDT
CO5	To explain the working principle of Digital tachometer.
CO6	To demonstrate the Multimeter and usage

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3		2	3		2	1	3	3	
	CO2			2			1								
	CO3	2			3				3		2	3			
	CO4		2			3	1	3		1		3			
	CO5	3									3	1	1		
	CO6	3			2		3		3		3				
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCAB305	**LEARNING AN ART FORM**	**L**	**T**	**P**	**C**
		2	0	0	0

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like Chaiti, Hori, Kajri and Birha.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306	INTANGIBLE CULTURAL HERITAGE (FESTIVALS, FOOD WAYS, LOCAL GAMES)	L	T	P	C
		2	0	0	0

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

- To study and document the prevalent social practices and beliefs regarding traditional foods;

- To study and document the feasts on religious and social occasions of different communities;
- To identify and document the food items consumed by different communities and determine their nutritional values;
- To conduct chemical analysis of food ingredients;
- To identify and document the kitchen generated health ingredients used by different communities;
- To find out the uses of leftover food stuff of different communities;
- To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and
- To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

U18BSMA402	**PROBABILITY STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course – Engineering Mathematics				
	Course Designed by:- Department of Mathematics				

COURSE OBJECTIVES:-

- Learn basics of probability, Baye's Theorem. Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases.
- Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample.
- Ability to apply knowledge of mathematics, science and engineering.
- Ability to analyze and interpret data
- Identify, formulate and solve equations by various methods

UNIT 1 PROBABILITY DISTRIBUTION 12

Probability – Axioms of probability – Conditional probability – Baye's theorem Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT II STATISTICS AND TESTING OF HYPOTHESIS 12

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

UNIT III SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 12

Bisection method, Newton-Raphson method and Regula-Falsi method for single variable-solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedal methods.

UNIT IV FINITE DIFFERENCE AND INTERPOLATION 12

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT V NUMERICAL DIFFERNTIATION AND INTEGRATION 12

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

TEXT BOOKS

1. Sastry. S. S "Introductory Numerical Methods" PHI, 2010.
2. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005.
3. S.C.Gupta & V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003.

REFERENCE BOOKS

1. Grewal, B.S. "Higher Engineering Mathematics (42^{nd} edition)" Khanna Publication Delhi, 2016.
2. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company, 2^{nd} Edition 2010.
3. Veerarajan T. "Probability Statistics and Random Process" Tata McGraw Hill, New Delhi 2003.

COURSE OUTCOMES (COs)	
CO1	To Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.
CO2	To Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
CO3	To Know the different display and recording devices for various bio signals
CO4	To Know the measurement techniques for blood flow measurement and cell counting
CO5	To Learn the uses of pH, spectrometers and auto-analyzer
CO6	To learn numerical approximation of definite integrals

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	1			2
	CO2			2					3				2		
	CO3	2			3						2				

	CO4					3		3		1			1		
	CO5	3	3						2		3	2			
	CO6														
3	Category	Professional Course (PC)													
4	Approval	47th Meeting of Academic Council													

U18PCBM401	MEDICAL INSTRUMENTATION I	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biosensors and Measurements				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- The students will be exposed to electrical and non-electrical physiological measurements and bio amplifiers.
- To know the various Bio potential amplifiers.
- To study about various Physiological measurements.
- To study about clinical laboratory instruments and blood cell counters.

UNIT I BIO POTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

UNIT II ELECTRODE CONFIGURATIONS 9

Bio signals characteristics – frequency and amplitude ranges- ECG – Einthoven's triangle. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

UNIT III BIO AMPLIFIER 9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers - Chopper amplifier.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETER 9

Temperature, respiration rate and pulse rate measurements. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V BIO-CHEMICAL MEASUREMENT 9

Biochemical sensors - pH, pO2 and pCo2, Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter.

TEXT BOOKS:

1. Arumugam.M, Textbook of Biomedical Instrumentation,2003.
2. Richard A. Norman "Principles of Biomedical Instrumentation" John Wiley and sons. New York.1988.

REFERENCE:.

1. Khanpur R.R., Handbook of Biomedical Instrumentation, Tata McGraw hill publishing company. New Delhi 1999.
2. Scott / Mathur "Textbook of Biomedical Instrumentation" CBS Publishers. Chennai 2007.

COURSE OUTCOMES (COs)	
CO1	To explain the purpose of measurement, the methods of measurements, errors associated with measurements.
CO2	To define the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
CO3	To classify the different display and recording devices for various bio signals
CO4	To Relate the measurement techniques for blood flow measurement and cell counting
CO5	To Demonstrate the uses of pH, spectrometers and auto-analyzer
CO6	To Explain non-invasive diagnostic parameters

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3		2		3	2	2			
	CO2			2					2			3	1		3
	CO3	2	3		3					2	2				
	CO4		3			3		3	2			1			
	CO5	3									3		1		
	CO6	3	3		2	3		2		3	2	2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM402	**FUNDAMENTALS OF BIOCHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biology for Engineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To get a clear idea of biomolecules and their functions
- To know the significance of biomolecules in biological systems
- To understand the metabolic pathways in normal and pathological conditions.

UNIT-1 INTRODUCTION TO BIOCHEMISTRY 9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT-II CARBOHYDRATE 9

Carbohydrate classification, Structure and Properties of Mono-di and Polysaccharides with its clinical importance .Biological importance of carbohydrates metabolism – Glycolysis, TCA cycle, Glycogenesis, ,Uronic acid pathway, metabolism of fructose, Sorbitol pathway, metabolism of galactose and its dysfunction.

UNIT-III PROTEIN 9

Classification of amino acids – characteristics of amino acids – Zwitterions, Iso-electric point. Protein classification. Structure of proteins, primary, secondary, tertiary and quaternary structure. Biological importance of polypeptides. Metabolism of ammonia, Urea cycle ,Metabolic disorders of glycine, Phenyl alanine, Tyrosine, Tryptophan. Metabolic defects of branched chain amino acids -maple syrup urine disease.

UNIT-IV LIPIDS 9

Classification of lipids. Structure and properties of compound lipids, Derived lipids - Biosynthesis of cholesterol ,Bile acids and its importance. β- oxidation of fatty acids. Ketogenesis .Disorder of lipid metabolism. Atherosclerosis, hypercholesterolemia and Fattyliver diseases.

UNIT-V ENZYMES, HARMONES AND NUCLEIC ACID 9

Enzymes – chemical nature. Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Hormones – chemical nature, properties of hormones and hormonal disorders. Structure of purines and pyrimidines, nucleoside, nucleotide, chargoffs rule. Watson and crick model of DNA. Structure of RNA and its types.

TEXT BOOKS:

1. RAFI MD ―Text book of biochemistry for Medical Student‖ Second Edition, University Press, 2014.
2. David.W.Martin, Peter.A.Mayes , Victor. W.Rodwell, ―Harper‘s Review of Biochemistry‖, LANGE Medical Publications, 1981.
3 Sathyanarayana, Textbook of Biochemistry, 2003.

REFERENCES:

1. Keith Wilson & John Walker, ―Practical Biochemistry - Principles & Techniques‖, Oxford University Press, 2009.
2. Pamela.C.Champe & Richard.A.Harvey, ―Lippincott Biochemistry Lippincott‘s Illustrated Reviews‖, Raven publishers,1994.
3 Harper's Illustrated Biochemistry - 26th edition Publisher: McGraw-Hill Medical; 26 edition 2003

COURSE OUTCOMES (COs)	
CO1	Classify the biomolecules according to their structure and applications.
CO2	Define the functions and properties of carbohydrates.
CO3	Distinguish different types of amino acids and proteins based on the biological aspects
CO4	Assess the significance of bio molecules in biological systems
CO5	To explain about all the enzyme activities.
CO6	Analyze the etiology and biological parameters in metabolic diseases

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1		3		3			3		2	1	2			
	CO2	2		2	3	1	2	3						2	
	CO3	2	3				2		1				1		

	CO4				3	3		3			1	2			
	CO5	2	3	2	3	3	2			3	1	2	1		
	CO6		3		3			3		2	1	2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM403	MEDICAL PHYSICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Semi Conductor Physics				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To Study effects of sound and light in human body
- To study effects of radiation in matter and how isotopes are produced
- To examine the somatic effects of radiation
- To correlate the genetic effects of radiation

UNIT I ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL APPLICATION 9

Light - Physics of light, Intensity of light, limits of Vision and color vision Sound – Physics of sound , Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) – Interaction of Ultrasound with Materials-Reflection and Refraction – Absorption and Scattering Non- ionizing Electromagnetic Radiation Tissue as a leaky dielectric – Relaxation Processes – Overview of non – ionizing radiation effects -Low Frequency Effect – Higher frequency effect.

UNIT II RADIOACTIVE DECAY 9

Radioactive Decay – Spontaneous Emission – Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture Principles of Nuclear Physics – Natural radioactivity, Decay series, Half life period, type of radiation and their applications. Production of radionuclides – Cyclotron produced Radionuclide - Reactor produced Radionuclide – fission and electron Capture reaction, Radionuclide Generator – Milking Process - Linear accelerator , Radionuclide used in Medicine and technology.

UNIT III INTERACTION OF RADIATION WITH MATTER 9

Interaction of charged particles with matter – Specific ionization , linear energy Transfer Range, Bremsstrahlung , Annihilation Interaction of Gamma radiations with matter – Photoelectric effect, Compton Scattering , pair Production, Attenuation of Gamma Radiation, Interaction of neuron with matter

UNIT IV PHYSICS OF CARDIOPULMONARY SYSTEM 9

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relationships of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O2 and CO2 exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulent

UNIT V RADIATION EFFECTS 9

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro-intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

TEXT BOOKS

1. B.H Brown , PV Law ford, R H Small wood , D R Hose , D C Barber , "Medical Physics and Biomedical Engineering", CRC Press, 1999.
2. Gopal B.Saha "Physics and Radiobiology of Nuclear Medicine" Springer, 3rd ed, 2006

REFERENCES:

1. John R. Cameron and James G. Skofronick, "Medical Physics", John–Wiley & Sons, 978.
2. RF Farr and PJ Allisy –Roberts, "Physics for Medical Imaging" Saunders, 1997.
3. P.Uma Devi, A. Nagarathnam, B S Satish Rao, "Introduction to Radiation Biology" B.I Churchill Livingstone pvt ltd, 2000.
4. S.Webb, "The Physics of Medical Imaging", Taylor and Francis, 1988.
5. https://www.iop.org/education/teacher/resources/teaching-medical-physics/page_54690.html

COURSE OUTCOMES (COs)	
CO1	To define about Ultrasound fundamentals.
CO2	To outline the Natural radioactivity, type of radiation and their applications.
CO3	To extend the knowledge of Interaction of charged particles with matter.
CO4	To list the Major components of cardiovascular system.
CO5	To define Photoelectric effect, Acute Radiation Effects.
CO6	To illustrate all the radiation effects and syndromes

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2					2	1		2	1			
	CO2						1			1			3		
	CO3	2			3				2						
	CO4			3	1		2	3				2			
	CO5	3	2						2		3	3	2		
	CO6	3		3	2	2	1		2	3					
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM404	**ANALOG AND DIGITAL COMMUNICATION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering Analog and Digital Integrated Circuits				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

UNIT II PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM,PWM,PPM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-array signalling M-array PSK & QAM – Comparison, ISI – Eye pattern, equalizers

UNIT IV INFORMATION CODING AND DECODING 9

Coding for error detection and correction, Block coding – coding, Hadamard code, Hamming code, Cyclic Codes, Convolution coding and decoding

UNIT V MULTIPLE ACCESS TECHNIQUES 9

Multiplexing: definition, purpose - Frequency division multiple access (FDMA) - Time division multiple access (TDMA) - Code-division multiple access (CDMA) - Comparison of multiple access techniques - Differences between multiple access and multiplexing - Wireless communication systems - Propagation issues in mobile radio

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, ―Principles of Communication Systems‖ 3/e, TMH 2007
2. S. Haykin ―Digital Communications‖ John Wiley 2005

REFERENCES:

1. B.P.Lathi, ―Modern Digital and Analog Communication Systems‖, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – ―Analog and Digital Communications‖ TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications‖ 2/e Pearson Education 2007.

COURSE OUTCOMES (COs)	
CO1	To list the different analog modulation schemes.
CO2	To demonstrate different pulse modulation techniques.
CO3	To define the different Digital Modulation Techniques.
CO4	To identify the error detection and correction mechanism

CO5	To outline the various Multiple Access Techniques														
CO6	To Understand the wireless communication														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1					3	2	3			1		2		
	CO2	2		2					3			2			
	CO3		3	2						3					
	CO4				3	3		3					2		
	CO5	2	3	2		3	2	3	3		1	2			
	CO6	2		2					3			2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM405	**BIOMATERIALS AND ARTIFICIAL ORGANS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Human Anatomy and Physiology				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Learn characteristics and classification of Biomaterials
- Understand different metals and ceramics used as biomaterials
- Learn polymeric materials and combinations that could be used as a tissue replacement implants
- Know the various artificial organs developed using these materials

UNIT I BIOMATERIALS AND BIOCOMPATIBILITY 9

Biocompatibility and hemo-compatibility, Overview of Biomaterials used as medical devices, Classification of biomaterials, Impact and future of biomaterials, performance of implants, Interfacial phenomena and tissue response to biomaterials. Electro kinetic factors. Types of orthopaedic fixation devices- pins, screws and plates, IM nails.

UNIT II ARTIFICIAL JOINTS 9

Bioelectric effect, Wolff's law. Interface problems with artificial joints and various fixation methods. Failure of implantation materials- metallic corrosion, wear, metallic implant fractures and their impact on biological systems. Hard tissue replacements- total hip and knee joint replacements.

UNIT III METALS AND POLYMERS 9

Metals and alloys for orthopaedic implants- Stainless steel, Cobalt chromium alloy, Titanium and its alloys .Polymers in biomedical use, Hydrogels, silicone rubber, biodegradable polymers, microorganisms in polymeric implants and polymer sterilization. Biopolymers, Synthetic polymers.Composites- Types and Applications.

UNIT IV BIOCERAMICS 9

Bioceramics, types – bioactive, resorbable, non-resorbable. Stoichiomety and Ca/P ratio of various forms calcium phosphates, bioceramic coatings on metallic implants and bone bonding reactions on implantation. Hydroxyapatite –properties and applications. Bone cements and bio glasses.Dental implants- materials, types and designs.

UNIT VBIOMATERIAL TESTING AND ARTIFICIAL ORGANS 9

Testing of biomaterials: In-vitro, in-vivo preclinical tests- Standards on biomaterials.- Biological Tests- biocompatibility methods for improvement, surface modification of materials -. Artificial Heart, eye and ear implants, artificial pancreas, ophthalmic implantation, extracorporeal artificial organs, neural prostheses.

TEXTBOOKS :

1. Joon Bu Park, Roderic S, Lakes, "Biomaterials", Springer-Verlag, New York Inc., 2010.
2. Ratner A, and S.Hoffman, B. D. "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press; 3 edition,November 8, 2012.

REFERENCES:

1. "Biomaterials", Sujata V Bhat., Narosa Publishing House, New Delhi, 2002.
2. A.F. Von Recum, "Handbook of Biomaterials Evaluation - Scientific, Technical and Clinical Testing of Implant Materials", 2nd Edn., Taylor & Francis, Philadelphia, 1999.
3. F. Silver and C. Dillon, " Biocompatibility: Interactions of Biological and Implantable Materials" Vol.1, VCH Publishers, New York, 1989.
4. Park. J.B. "Biomaterials: An Introduction", CBS Publishers, 2007.

COURSE OUTCOMES (COs)															
CO1	To Analyze different types of Biomaterials and its classification**.**														
CO2	To experiment with combinations of materials that could be used as a tissue replacement implant.														
CO3	To label about the various polymeric materials used for medical applications														
CO4	To explain about bio-ceramics and its applications in medicine														
CO5	To interpret the applications and properties of materials in orthopaedics														
CO6	To Design biocompatible organs														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3		2		2	2	1			3
	CO2			2						3			2		
	CO3	2	2		3		2		1		2				
	CO4					3		3				1			
	CO5	3	3							2	3	3	3		
	CO6	3	3		2	3		2		2	2	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCTH502	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	0	0	0

The objective of the course is four fold:

Sensitization of student towards self, family (relationship), society and nature.

Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.

Strengthening of self reflection.

Development of commitment and courage to act.

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

U18PCBM4L1	BIOCHEMISTRY LAB	L	T	P	C
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Human Anatomy and Physiology Lab				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce the basics of Carbohydrates, Proteins and Amino acids.
- To identify the different Types of Carbohydrates-Monosaccharides, Disaccharides and Polysaccharides.
- To identify the Aminoacids.

LIST OF EXPERIMENTS:

1. Qualitative analysis of Carbohydrates.
2. Estimation of Glucose by Benedict's Method.
3. Estimation of Protein by Lowry's Method.
4. Estimation of Protein by Biuret's Method.
5. Estimation of DNA by Diphenyl amine method..
6. Isolation of Starch from Potato.
7. Estimation of Amino acid by Ninhydrin method.
8. Estimation of Creatinine by Jafe's method.
9. Abnormal Urine analysis (Glucose, Protein, Acetone, etc.)

COURSE OUTCOMES (COs)	
CO1	To Qualitative analysis of Carbohydrates
CO2	To Estimate the Biomolecules by different methods
CO3	To Isolate the Starch
CO4	To Estimate the DNA
CO5	To find the Abnormal constituents of blood
CO6	To find protein functions
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1			3		3	2	3			1		1	2	
	CO2	2									1				
	CO3			2					3	3		2	1		
	CO4					3	2	3							
	CO5	2	3	2					L		1	2	3		
	CO6			3		3	2	3			1		1		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM4L2	**ANALOG AND DIGITAL COMMUNICATION SYSTEM LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Basic Electrical and Electronics Engineering Lab				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn various analog modulation techniques
- To understand various digital modulation techniques

List of Experiments

1. Signal Sampling and reconstruction
2. Amplitude modulation and demodulation
3. Frequency Modulation and Demodulation
4. PAM, PWM, PPM
5. Delta and Adaptive Delta Modulation
6. Pulse code modulation
7. BPSK Modulation and Demodulation
8. BFSK Modulation and Demodulation
9. QPSK Modulation and Demodulation
10. TDM, FDM

COURSE OUTCOMES (COs)	
CO1	To explain different analog modulation techniques.
CO2	To Demonstrate Knowledge on frequency shift keying
CO3	To illustrate the concept of digital transmission.
CO4	To compare analog and digital communication techniques.
CO5	To interpret the BPSK transmission techniques.
CO6	To illustrate the TDM and FDM techniques.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**

2	CO1					3	2	3			1		3		2
	CO2	2		2					3			2			
	CO3		3	2						3			3		
	CO4				3	3		3							
	CO5	2	3	2		3	2	3	3		1	2			
	CO6					3	2	3			1		3		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCAB407	LITERATURE, CINEMA AND MEDIA (WORKSHOP, READING MULTIPLE NEWS SOURCES,ANALYZE ADS)	L	T	P	C
		0	0	2	0

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description.

Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not just the literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A

well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408	LITERATURE & MEDIA GROUP READING (SAAMUHIKVAACHAN) OF CLASSICS.	L	T	P	C
		2	0	0	0

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

U18PCBM501	BIOCONTROL SYSTEMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical and Electronics Engineering				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To design the physiological systems
- To analyze the systems in time and frequency domain and to understand the concept of stability.
- To apply mathematical modelling principles in understanding the various fundamental biological systems.

UNIT I: SYSTEM CONCEPTS 9

Basic structure of control system -Types of systems - Open loop systems, closed loop systems, Effects of feedback, Block diagram & Signal flow graph, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

UNIT II: TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS 9

Step and Impulse responses of first order and second order systems, Determination of time domain specifications of first and second order systems from its output responses.

UNIT III: THE CONCEPT OF STABILITY & ROOT LOCUS TECHNIQUE 9

Concept of stability, Routh stability criterion qualitative stability and conditional stability. The Root locus concept, Construction of root locus.

UNIT IV: FREQUENCY RESPONSE ANALYSIS 9

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, Determination of gain margin and phase margin using Bode plot.

UNIT V: BIOMEDICAL APPLICATIONS 9

Cardiovascular Control System, Endocrine Control Systems, Pupil Control System, Skeletal Muscle, Servomechanism, Neuro muscular system, Respiratory system, occulomotor system.

TEXT BOOKS:

1. M. Gopal "Control Systems Principles and design", Tata McGraw Hill ,2002
2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 1995
3. Michael C K Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2001.

REFERENCES

1. John Enderle, Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering" second edition, Academic Press, 2005.
2. Richard C. Dorf, Robert H. Bishop," Modern control systems",Pearson, 2004

COURSE OUTCOMES (COs)	
CO1	To know about the process of neurophysiology.
CO2	To gain knowledge about the neural networking process such as back propagation
CO3	To have a fundamental knowledge of pattern recognition
CO4	To have skills about the manipulating, transforms using classifiers theorems.
CO5	To acquire the skills cluster analysis and feature extraction
CO6	To Learn about all the human control system

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			3	2			2			1			3
	CO2		3	2			3						1		
	CO3	2			3						3				
	CO4			3		3		2				1			
	CO5		3	2							3	3	2		
	CO6	3			3	2			2			1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM502	**MEDICAL INSTRUMENTATION II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Medical instrumentation- 1				
	Course Designed by:-Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Gather basic knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.
- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

UNIT-I HEART LUNG MACHINE AND CARDIAC ASSIST DEVICES 9

Condition to be satisfied by the H/L system, different type of Oxygenators, pumps- Blood handling system, Synchronous counter pulsation, right ventricular bypass pump, left ventricular bypass pump, Intra aortic balloon pumping and veno arterial pumping.

UNIT II RESPIRATORY MEASUREMENT STSTEM 9

Instrumentation for measuring the mechanics of breathing – Spiro meter, – Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT-III ARTIFICIAL KIDNEY AND SENSORY MEASUREMENT 9

Indication and Principle of Hemodialysis, different types of dialysis, monitoring systems, artificial kidney,Psycho Physiological Measurements-for testing sensory Responses, Electro occulograph, Audiometer-Pure tone, Speech. EGG (Electrogastrograph), galvanic skin resistance (GSR), polygraph.

UNIT IV PATIENT MONITORING AND BIOTELEMETRY 9

Patient monitoring systems, ICU/CCU Equipment, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT V - DIAGNOSTIC EQUIPMENTS 9

Endoscopy – Laparoscopy – thermograph- Lithotripsy -Cryogenic Equipment - Automated drug delivery system – Components of drug infusion system – Implantable infusion systems. Physiological effects of electricity – important susceptibility parameters – Macro shock, Micro shock hazards, Patient‘s electrical environment.

TEXTBOOKS:

1. Albert-N. Cook & Webster. J. G. Therapeutical medical devices, Prentice hall INC, New Jersey, 1982.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.
3. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, “Biomedical Instrumentation and Measurements”, Prentice-Hall India, 2nd Edition, 1997

COURSE OUTCOMES (COs)															
CO1	To describe about measurements of parameters related to respiratory system														
CO2	To describe the measurement techniques of sensory responses														
CO3	To list the different types of patient monitoring parameters														
CO4	To understand the importance of patient safety against electrical hazard														
CO5	To acquire knowledge about drug delivery systems														
CO6	To describe about measurements of parameters related to respiratory system														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	3			3
	CO2		1	2			3	3	3				1		
	CO3	2			3						2	2			
	CO4					3	2	3	2			1			
	CO5	3	2	1				3	1		3	3	2		
	CO6	3			2	3		2			2	3			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM503	DIGITAL SIGNAL PROCESSING FOR BIO ENGINEERS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Partial Differential Equation and Transformation				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn discrete concepts of Signals and Systems
- To Understand Concepts of Z Transform and its properties
- To learn discrete Fourier transform and its properties
- To know the characteristics of FIR filters
- To know the characteristics of IIR filters

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

UNIT II DISCRETE TIME SYSTEMS - Z TRANSFORM 9

Z transform and its properties-Convolution, Inverse Z transform-Discrete Fourier series Properties-Sampling the Z transform-Discrete Fourier transform-Properties for frequency domain analysis-Linear Convolution using discrete Fourier transform-Overlap save method.

UNIT III DISCRETE FOURIER TRANSFORMS 9

Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

UNIT IV FIR FILTER DESIGN 9

FIR design-Fourier Series Method –Window function Method, triangular window, rectangular window, Hamming window, Hanning window functions, Kaiser window. Applications of Signal Processing in Biomedical Engineering.

UNIT V IIR FILTER DESIGN 9

Classification-Reliability constraints-IIR design-Butterworth and Chebyshev Filters, Bilinear Transform Method-Impulse Invariant Method-Step Invariance Method.

TEXT BOOK:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.

REFERENCES:

1. Emmanuel C..Ifeachor, &Barrie.W.Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006.

COURSE OUTCOMES (COs)															
CO1	To list the different types of signals and systems														
CO2	To describe the discrete time systems and its properties														
CO3	To apply Z transform for the analysis of digital signals & systems														
CO4	To apply DFT for the analysis of digital signals & system														
CO5	To design FIR and IIR filter														
CO6	To apply various window functions in biomedical applications														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	2			3	3		3		3	1	1			3
	CO2		3	2			2	3	1				1		
	CO3				3	3					2	2			
	CO4	2					2	3	3	2	1				
	CO5	2	3	2	3	3		3					2		
	CO6	2			3	3		3		3	1	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18HSBA401	**ORGANIZATIONAL BEHAVIOR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Knowledge on Managements				
	Course Designed by:- Department of Management Studies				

COURSE OBJECTIVES:-

- Understanding the basic approaches in organization
- Knowledge on theories of Personality
- Clear sight on the Decision Making in Groups
- Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
- Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

UNIT I **9 hours**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9 hours**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9 hours**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9 hours**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9 hours**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

COURSE OUTCOMES (COs)	
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour
CO2	Knowledge of the Interpersonal perception
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Familiarity with the knowledge of types of Conflicts
CO6	Understanding the Concept of management Culture

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			3			3	3		1	3		1	
	CO2					3	2	3					1		
	CO3	2	3	3				3		3	1	2			
	CO4	2			3			3			1	3			
	CO5	2	3	2	3		2	3	3		1		2		
	CO6	3			3			3	3		1	3			
3	Category	Humanities and Social Science including Management Courses (HS)													
4	Approval	48th Meeting of the Academic Council													

U18MCTH401 CONSTITUTION OF INDIA – BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted

into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

- Meaning of the constitution law and constitutionalism
- Historical perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India
- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy – Its importance and implementation
- Federal structure and distribution of legislative and financial powers between the Union and the States
- Parliamentary Form of Government in India – The constitution powers and status of the President of India
- Amendment of the Constitutional Powers and Procedure
- The historical perspectives of the constitutional amendments in India
- Emergency Provisions : National Emergency, President Rule, Financial Emergency
- Local Self Government – Constitutional Scheme in India
- Scheme of the Fundamental Right to Equality
- Scheme of the Fundamental Right to certain Freedom under Article 19
- Scope of the Right to Life and Personal Liberty under Article 21

U18PCBM5L1	MEDICAL INSTRUMENTATION LAB	L	T	P	C
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Biosensors and Measurements lab				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Gather basic knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.
- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

LIST OF EXPERIMENTS:

1. ECG recording and Analysis.
2. EEG recording and analysis.
3. Respiratory Analysis.
4. Blood Pressure Measurement System.
5. Nerve Conduction Study.
6. Digital Heart Monitor.
7. EOG system
8. Study of ESU – cutting and coagulation modes
9. pH Measurement and conductivity test.
10. Spectrophotometer.
11. Flame photometer.
12. ELIZA.
13. Plotting of human auditory response using audiometer
14. Analysis of bio signals using FFT Spectrum Analyser
15. Ultra Sound Dopplers.
16. Defibrillators and Pacemakers (Demo)

COURSE OUTCOMES (COs)	
CO1	To learn recording systems of EEG and ECG
CO2	To Acquire knowledge on diathermy units
CO3	To determine concentration of certain metal ions in chemical components
CO4	To determine the quantitative analysis of molecules
CO5	Able to detect antibodies in our blood
CO6	Learns pH measurement

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	3			3
	CO2		1	2			3	3	3				1		
	CO3	2			3						2	2			
	CO4					3	2	3	2			1			
	CO5	3	2	1				3	1		3	3	2		
	CO6	3			2	3		2			2	3			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM5L2	**DIGITAL SIGNAL PROCESSING FOR BIO ENGINEERS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Partial Differential Equation and Transformation				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To gain the practical knowledge about the various bio signals and its characteristics

LIST OF EXPERIMENTS

1. Representation of basic discrete time signals
2. Computation of convolution –linear convolution
3. Response of a difference equation to initial conditions; stability
4. DFT and FFT computation
5. FIR filter design using windowing techniques
6. IIR filters design-digital Butterworth filter
7. IIR filters design-digital Chebyshev filter
8. Analysis of ECG signals.
9. Analysis of EEG signals
10. Analysis of EMG signals

COURSE OUTCOMES (COs)	
CO1	To represent the basic discrete time signals and analyze it
CO2	To represent time series signal and convolve them
CO3	To compute the DFT and FFT
CO4	To design the IIR and FIR filter
CO5	To analyze various types of bio signals and study its characteristics
CO6	To learn window techniques for filtering signals

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	1			3
	CO2	3							2		3		2		
	CO3	3		2				1							
	CO4			2			3			3			1		
	CO5	2			3		1		3		2				
	CO6	3				3		2			2	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCAB509	**SOCIAL AWARENESS (ARTISANS-RELATES TO ENGG., VISIT TO HOSPITALS, ORPHANAGES, POLICESTATION, COURTS, TRAUMA CENTERS, CONSUMER FORUMS)**	**L**	**T**	**P**	**C**
		0	0	2	0

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in BanarasiSaari, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of actions.

U18MCAB510	SOCIAL SERVICE / NSS	L	T	P	C
		0	0	2	0
(Teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer)					

U18PCBM601	PATHOLOGY AND MICROBIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biology for Engineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Gain a knowledge on the structural and functional aspects of living organisms.
- Know the etiology and remedy in treating the pathological diseases
- To learn about the cell structure and its disorders
- To gain knowledge about the fundamental structure of virus, bacteria and its causes
- Empower the importance of public health.

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA 9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT-II FLUID AND HAEMODYNAMIC DERANGEMENTS 9

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas, Haemorrhage.

UNIT V MICROBIOLOGY 9

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoan, virus and helminthes.

UNIT V MICROSCOPES 9

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining

UNIT V IMMUNOPATHOLOGY 9

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE.Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

TEXT BOOKS:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, ―Pathologic Basis of Diseases‖, 7th edition,WB Saunders Co. 2005 (Units I & II).
2. Ananthanarayanan&Panicker, ―Microbiology‖ Orientblackswan, 2017 10th edition. (Units III,IV and V).

REFERENCES:

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. ―A Text Book of Microbiology‖ Chand & Company Ltd, 2007 3. Prescott, Harley and Klein, ―Microbiology‖, 10th edition, McGraw Hill, 2017

COURSE OUTCOMES (COs)															
CO1	To have a Fundamental Knowledge about the cell and concepts of tumor.														
CO2	To have to learn about the fluid present in the body and hemodynamic derangement														
CO3	To discuss the importance of public health and describe methods involved in treating the pathological diseases														
CO4	To have knowledge about basic concepts of infection and immunity of the human body														
CO5	To acquire the fundamental knowledge of structure of Bacteria, virus and its causes.														
CO6	To know the uses of various microbiology based techniques														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	1		2	3	3	2			2			2	
	CO2			2			2		3			3	2		
	CO3	2	2		3		2				2				
	CO4			3		3		3				3	3		
	CO5	3					3		2		3				
	CO6	3	1		2	3	3	2			2				
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM602	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Medical Instrumentation I & II				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- Gain knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.
- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor. Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External.

UNIT II NEUROLOGICAL EQUIPMENT 9

Multi channel EEG recording system, Clinical significance of EEG- Epilepsy, Evoked Potential Signals–, EEG Bio Feedback Instrumentation, MEG (Magneto Encephalo Graph) - sensing principle and instrumentation (Block diagram)

UNIT III SKELETAL MUSCULAR EQUIPMENT 9

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV DIATHERMY 9

IR and UV lamp - application. Need for different diathermy units, Short wave diathermy, ultrasonic diathermy, Microwave diathermy. Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level.

UNIT V ULTRASONIC TECHNIQUE & PATIENT SAFETY 9

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology. Electrical safety codes and standards, Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electrical safety of medical equipment.

TEXT BOOKS:

1. Leslie Cromwell, Fred J. Seibel, Erich A. Pfeiffer, ―Biomedical Instrumentation and Measurement‖, Prentice Hall India Pvt. Ltd., New Delhi, 2nd Edition, Reprint, 2013.
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical equipment technology, Pearson Education, 4th edition, 2008.

REFERENCES:

1. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
2. Richard Aston ―Principles of Biomedical Instrumentation and Measurement‖ – Merril Publishing Company, 1990.

3. L.A Geddes and L.E.Baker, ―Principles of Applied Biomedical Instrumentation‖, John Wileyand Sons, Reprint 2008
4. John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 2009.
5. Myer Kutz ―Standard Handbook of Biomedical Engineering & Design‖ – McGraw-Hill Publisher, 2003.
6. Antony Y.K.Chan,‟‟ Biomedical Device technology, Principles and design‟‟, Charles

COURSE OUTCOMES (COs)	
CO1	o apply different medical devices in the measurement of parameters related to cardiology
CO2	To explain the recording method of EEG
CO3	To measure and analyse signals generated by muscles
CO4	To analyse different types of diathermy units
CO5	To list the applications of ultrasound in medical field
CO6	To differentiate the diagnostic and therapeutic equipment's

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	2		2					3			2			3
	CO2	3			3	3	2				1		1		
	CO3		3	2			2	3		2	1		2		
	CO4	2			3	1									
	CO5		3	2	3		3	3	1		1				
	CO6	2		2					3			2			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM603	**RADIOLOGICAL EQUIPMENTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Medical Instrumentation I& II				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To discuss the radiation therapy techniques and radiation safety

UNIT I: X – RAYS **9**

Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, dental X- ray units.

UNIT II: COMPUTER TOMOGRAPHY **9**

Principle, Plane of Movement, Multi section Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography.

UNIT III: MAGNETIC RESONANCE IMAGING **9**

Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterisation, MR Spectroscopy, Functional MRI.

UNIT IV: EMISSION IMAGING **9**

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT.

UNIT V: RADIATION THERAPY USING X – RAYS AND ISOTOPES **9**

Direct and Indirect effects of high energy radiation, Units for radiation Exposer, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

TEXT BOOKS:

1. Steve Webb, ―The Physics of Medical Imaging‖, Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
2. R.Hendee and Russell Ritenour ―Medical Imaging Physics‖, Fourth Edition William, Wiley Liss, 2002**.**

REFERENCES:

1. Gopal B. Saha ―Physics and Radiobiology of Nuclear Medicine‖- Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, ―Medical physics and Biomedical Engineering‖, - CRC Press, 1999.
3. Myer Kutz, ―Standard handbook of Biomedical Engineering and design‖, McGraw Hill, 2003.
4. P.Ragunathan, ―Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques‖, Paperback – Import, 2007

COURSE OUTCOMES (COs)	
CO1	To describe the working principle of X ray machine and its application
CO2	To illustrate the principle computed tomography
CO3	To interpret the technique used for visualizing various sections of the body using magn resonance imaging
CO4	To demonstrate the applications of radio nuclide imaging
CO5	To outline the methods of radiation safety.
CO6	To learn radiation hazards and precaution steps

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2		2	3		2	1						3
	CO2			2			1			1					
	CO3		1		3				2		2				
	CO4						2	3		2		2			
	CO5	3	2						2		3	3	2		
	CO6	3		3	2			3	2						
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM604	TELEMEDICINE	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite course – Analog and Digital Communication				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce telemedicine advancements in telemedicine .Benefits of telemedicine , Functional Block of a telemedicine system, Tele healthcare and E-medicine.
- To study Communication infrastructure for telemedicine LAN and WAN technology Satellite communication Mobile hand held devices and mobile communication Internet technology and telemedicine using World Wide Web Video and audio conferencing.
- Introduction to Network Configuration , circuit and packet switching.
- To learn Ethical and legal issues of Telemedicine - Confidentiality and the law – Patient rights and consent - Access to medical Records.

UNIT I - FUNDAMENTALS OF TELEMEDICINE 6

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits &limitations of telemedicine.

UNIT II -TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 6

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 6

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 6

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE 6

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, eHealth and Cyber Medicine.

TEXT BOOK

1. Olga Ferrer-Roca, M.Sosa Ludicissa, **"**Handbook of Telemedicine", IOS press 2002.
2. Norris A.C, "Essentials of Telemedicine and Telecare", John Wiley & Sons, 2002
3. Wootton R, Craig J, Patterson, "Introduction to Telemedicine", Royal Society of Medicine Press Ltd. (2nd ed.), 2006.

REFERENCE BOOK

1. Maheu M.M, Whitten P, Allen A, "E-Health, Telehealth, and Telemedicine", Jossy-Bass, 2001.
2. Keith J, Dreyer, David S, Hirschron, James Thrall H, Amit Mehta, "PACS: A Guide to the Digital Revolution", 2nd Edition, Springer.

3. Huang H K, "PACS and imaging informatics – Basic Principles & application", Wiley-Blackwell
4. Latifi R, "Current Principles and Practices of Telemedicine and e-Health". Washington DC: IOHS , 2008.
5. Bashshur R L, Shannon G W, "History of Telemedicine", New Rochelle. NY, Mary Ann Liebert Publishers,2009.

COURSE OUTCOMES (COs)	
CO1	To learn about the telemedicine
CO2	To study about the communication and networking system in telemedicine
CO3	To have a knowledge about the standards of telemedicine and encryption
CO4	To get knowledge about uses of telemedicine
CO5	To aware about laws of telemedicine
CO6	To learn about broadband technologies

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3	1	2			2	1		2	
	CO2			2					2				2		
	CO3	2	3		3		2			2	2	3			
	CO4					3		3	2						
	CO5	3									3				
	CO6	3			2	3	1	2		2	2	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM6L1	**PATHOLOGY AND MICROBIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Anatomy and Physiology Lab				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn about the morphology of Cells
- To gain knowledge about the cultivation and identification of microbes

LIST OF EXPERIMENTS:

1. Peripheral smear study
   (i) Morphology.
   (ii) Different count
   (iii) Total count.
2. Study on inclusion bodies.
3. Antigen-Antibody reaction Immuno electrophoresis.
4. Simple staining.
5. Gram staining.
6. Acid-fast staining.
7. IMVIC test.
8. Oxidase-Citrate.

9. Hydrogen sulphide test.
10. Sterilisation of Media.
11. Preparation of Media (solid & Liquid Media)
12. Cultivation of microbes (pour plate, Streak plate, Spread Plate method)
13. Antibiotic sensitivity test

COURSE OUTCOMES (COs)	
CO1	To have a Fundamental Knowledge about the culture techniques.
CO2	To have knowledge about basic concepts of Media and Culture of Microbes.
CO3	To acquire the fundamental knowledge of antibiotic Sensitivity.
CO4	To know the uses of various microbiology based techniques
CO5	To have a Fundamental Knowledge about the culture techniques.
CO6	To Learn about morphology of different microorganisms

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3	3	2			2	1		2	
	CO2			2									2		
	CO3	2			3		3		2		2				
	CO4		1	2		3	2	3				3			
	CO5	3					3		3	2	3	3	2		
	CO6	3			2	3	3	2			2	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM6L2	**VIRTUAL MODELING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Digital Signal Processing Lab for Bio Engineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To gain the practical knowledge about the various bio signals and its characteristics with Lab view
- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization

LIST OF EXPERIMENTS

1. Basic arithmetic operations
2. Boolean operations
3. Sum of ‘n’ numbers using ‘for’ loop
4. Factorial of a give number using for loop
5. Array maximum and minimum
6. Flat and stacked sequence
7. Median filter
8. Discrete cosine transform
9. Convolution of two signals

10. Windowing technique
11. Instrumentation of an amplifier to acquire an ECG signal
12. Acquire, analyse and present an EEG using virtual instrumentation

COURSE OUTCOMES (COs)	
CO1	To represent the Basic arithmetic operations and analyze it
CO2	To analyze the Discrete cosine transform
CO3	To analyze various types of Windowing technique
CO4	To acquire ECG signal
CO5	To represent EEG using virtual instrumentation
CO6	To execute datas in a availed frame

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2		3	2	
	CO2			2			3			3		3			
	CO3	2			3		1		3		2	2	2		
	CO4		1			3		3							
	CO5	3							2		3	3	3		
	CO6	3			2	3		2			2		3		
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCAB611	**SPIRITUAL, MINDFULNESS AND MEDITATION**	**L**	**T**	**P**	**C**
		0	0	2	0

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-

occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:
Reading (10 books/ narrations)
Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more)
Sessions: multiple 10-day sessions may be organized over a semester.

U18MCAB612	RELIGION AND INTER-FAITH	L	T	P	C
		0	0	2	0

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.
The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.
Following activities must be included.

- Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under 'book reading'.)
- Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

U18PCBM701	DIGITAL AND MEDICAL IMAGE PROCESSING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Digital signal processing for bioengineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- The aim of the courses to show how to extract, model, and analyze information from medical data
- To understand application in order to help diagnosis, treatment and monitoring of diseases through computer sciences.

UNIT-I DIGITAL IMAGE FUNDAMENTAL 9

Fundamental steps in DIP, Components of digital image processing system, Structure of human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition, Image formation model, Pixels, Basic relationship between pixels, coordinate conventions, Imaging Geometry, sampling and quantization, Basic geometric transformations.

UNIT-II IMAGE TRANSFORM 9

Definition of image transforms, Need for transforms, applications, Two dimensional Fourier transform, properties, Walsh, Hadamard, Discrete Cosine Transform, Haar, Karhunen – Loeve transforms

UNIT-III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order

Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT-IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT-V RECONSTRUCTION OF MEDICAL IMAGES 9

Image reconstruction from projections - Radon transforms, inverse radon transform - Filter back projection algorithm, Fourier reconstruction of MRI Images- Reconstruction of PET, SPECT and fMRI images

TEXT BOOK:

1. Kavyan Najarian and Robert Splerstor ”Biomedical Signals and Image Processing”, CRC – Taylor and Francisn, New York, 1991
2. John L. Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc., New York, 2004

REFERENCES:

1. **http://www.cs.uu.nl/docs/vakken/ibv/reader/readerINFOIBV.pdf**

COURSE OUTCOMES (COs)															
CO1	To have a Fundamental Knowledge of digital image processing with Fourier transforms														
CO2	To acquire knowledge about the image sampling, Modelling and quantization														
CO3	To have a fundamental knowledge of image enhancement, its process and types of filters used in image processing														
CO4	To have knowledge about image analysis, classification and reconstruction of act and MRI images														
CO5	To acquire the skills in the transmission of biological images.														
CO6	To reconstruct radiological images														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			3	2			2			1		3	
	CO2		3	2						3			1		
	CO3	2			3		3				3				
	CO4			3		3		2		2		2			
	CO5		3	2							3	3	2		
	CO6	3			3	2			2						
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM702	ROBOTICS AND NANOTECHNOLOGY IN MEDICINE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Medical Instrumentation I & II				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce about basic principle of robotics and nanotechnology
- To understand the basics of Robotics, Kinematics.
- To explore various applications of Robots in Medicine.

UNIT I: INTRODUCTION **9**

Geometric configuration of robots - manipulators - drive systems - internal and external sensors – end effectors - control systems - robot programming languages and applications - Introduction to robotic vision

UNIT II: ROBOTIC SURGERY **9**

Surgical robots-types, advances and advantages. Technologies involved in robotic surgery-sensors, actuators, micromechanics, communication control, virtual reality and artificial intelligence.

UNIT III: MOBILE ROBOTICS **9**

Architecture for advanced mobile robotics, actuator design, navigation, obstacle avoidance, sensors and vision systems. Legged robotic devices, control of mobile robots in semi structured environment

UNIT IV: ADVANCES IN MICROMECHATRONICS **9**

Robot force control strategies, autonomous mobile multi jointed systems. Development of specialized sensors for online monitoring of biological parameters, computer assisted surgery, rehabilitation robotics in virtual environment, applications in unstructured environment.

UNIT V: BIOMEDICAL APPLICATIONS **9**

Nerve cell repair using micro mechatronics, micro and Nano devices for targeted delivery of medicines to tumour sites . Surgeries performed using robotic systems TECAB, mitral valve surgery, bariatric surgery, minimally invasive surgeries. Surgical procedures in general surgery, neurology, urology, gasteroenterology, cardiology, Orthopedics, paediatrics and radio surgery

TEXT BOOK

1. Niku Saeed B, Introduction to Robotics: Analysis, System, Applications, PHI Publishers.
2. Tony Hyland, Scientific and Medical Robotics, Smart Apple Media Publishers, 2007.
3. Hari Singh Nalwa, "*Nanostructured Materials and Nanotechnology*", Academic Press, 2002.

COURSE OUTCOMES (COs)	
CO1	To study about Definition and origin of robotics
CO2	To learn about Hydraulic, pneumatic and electric drives determination
CO3	To introduce about Construction of manipulators – manipulator dynamics
CO4	To learn about basic concepts of Nano science and technology
CO5	To study about material processing by Sol – Gel method
CO6	To design robotic arms

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	1		2	
	CO2			2						3		3	1		
	CO3	2			3		1		3		2		1		
	CO4		1			3		3							
	CO5	3									3	3			
	CO6	3			2	3		2			2	1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18PCBM703	**HEALTH, HOSPITAL AND EQUIPMENT MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Medical Instrumentation				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn about the Health, Hospital and Equipment management.
- To understand the overview of Hospital Organization and Planning.
- To study about various types of communication and safety aspects in Hospital.

UNIT-I HEALTH SYSTEM 9

Health organization of the country, the state, the cities and the region, Health Financing System, Organisation of Technical Section.

UNIT-II HOSPITAL ORGANISATION AND MANAGEMENT 9

Management of Hospital Organization. Nursing section Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human relation in Hospital. Importance to Team Work, Legal aspect in Hospital Management

UNIT-III REGULATORY REQUIREMENT AND HEALTH CARE CODES 9

FDA Regulation, joint commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPC.

UNIT-IV EQUIPMENT MAINTENANCE MANAGEMENT 9

Organizing Maintenance Operations, Paperwork Control, Maintenance Job, Planning Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Mainframe.

UNIT-V TRAINED TECHNICAL PERSONNEL 9

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in Hospital.

TEXTBOOKS:

1. Kunders G D, “Biomechanics: Hospitals, facilities planning and management”, Tata McGraw Hill, 2008.

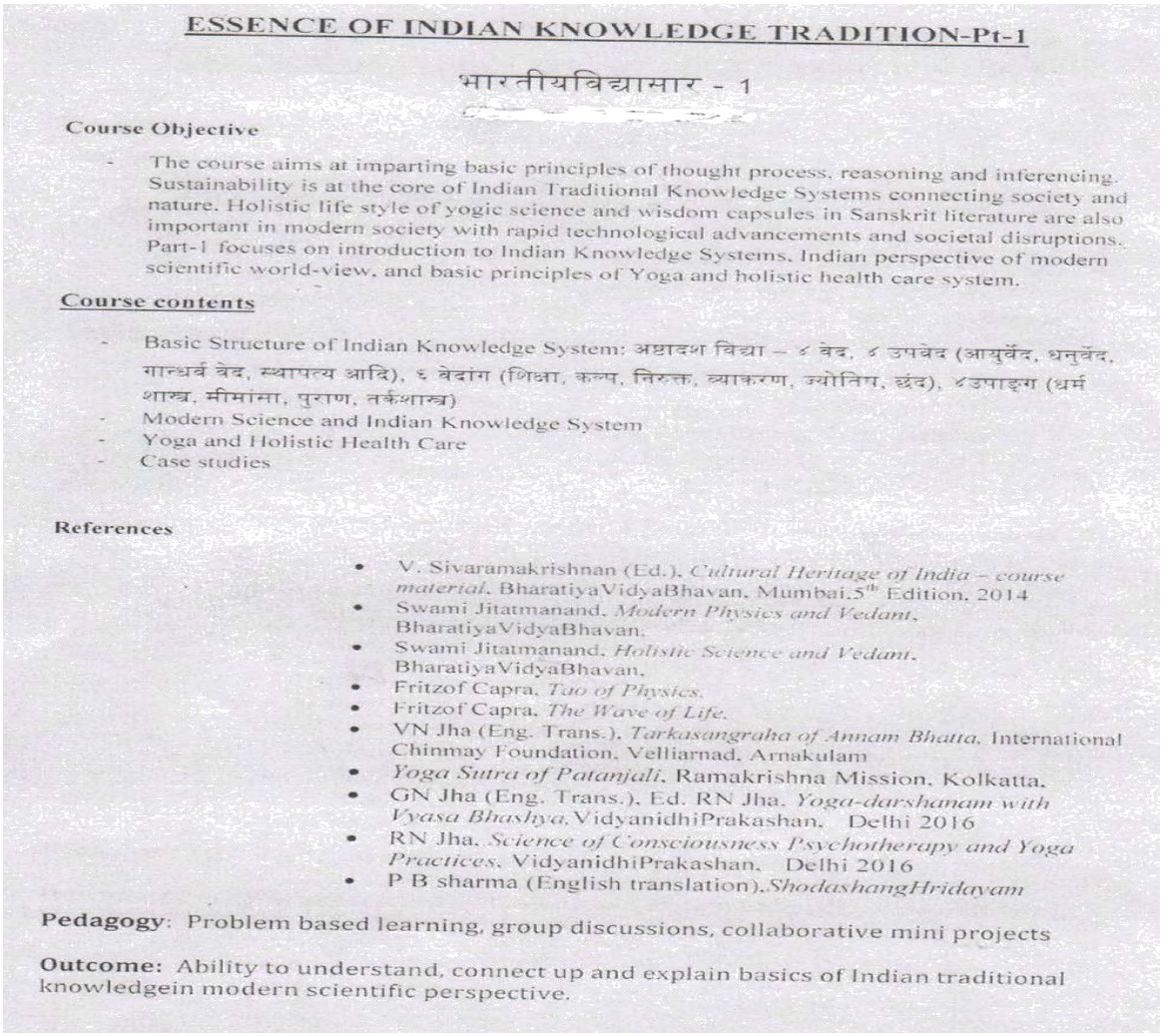
2. Sakharkar B M, "Principles of hospital administration and planning", Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.

REFERENCES:

1. Cesar A. Caceres and Albert Zara, The Practice of Clinical Engineering. Academic Press, 1977.
2. Webster, J. G. and Albert M. Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Eng/ewood Cliffs, 1979.
3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.
4. Hans Pfeiff Vera Dammann (Ed.) Hospital Engineering In Developing Countries, Z report Eschborn, 1986.
5. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press. San Diego 1988.
6. R.C.Goyal. Handbook of Hospital Personal Management. Prentice Hall of India. 1993.
7. http://www.scribd.com/doc/18278414/Hospital-management#scribd

COURSE OUTCOMES (COs)															
CO1	To gain Knowledge about the Health Organization of the Country.														
CO2	To acquire well defined knowledge in Hospital Organization and Management														
CO3	Develop the fundamental knowledge of regulatory requirements and Health Care Codes														
CO4	To know the skills of Equipments Maintenance Management														
CO5	To understand the functions and role of Clinical Engineers.														
CO6	To study about the role of Biomedical Engineers in Hospitals														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			3	2			2			1		2	
	CO2		3	2			3			1			1		
	CO3	2			3						3				
	CO4			3		3	2	2				2			
	CO5		3	2			L			3	3		2		
	CO6	3			3	2			2			1			
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCTH603	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0



ESSENCE OF INDIAN KNOWLEDGE TRADITION-Pt-1

भारतीयविद्यासार - 1

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-1 focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course contents

- Basic Structure of Indian Knowledge System: अष्टादश विद्या – ४ वेद, ४ उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्व वेद, स्थापत्य आदि), ६ वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद), ४उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health Care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai.5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan.
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan.
- Fritzof Capra, *Tao of Physics*.
- Fritzof Capra, *The Wave of Life*.
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkatta.
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*,VidyanidhiPrakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, VidyanidhiPrakashan, Delhi 2016
- P B sharma (English translation),*ShodashangHridayam*

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

U18PCBM7L1	IMAGE PROCESSING LAB	L	T	P	C
	Total Contact Hours – 45	0	0	2	1
	Prerequisite course – Digital Signal Processing Lab for Bioengineers				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To practice the basic image processing techniques.
- To analyze various types of bio image and study its characteristics.
- To enhance the medical images by applying various filters.

LIST OF EXPERIMENTS:

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Spatial filtering
4. Non-linear Filtering.
5. Edge detection using Operators.

6. 2-D DFT and DCT.
7. Filtering in frequency domain.
8. Display of color images.
9. Conversion between color spaces.
10. DWT of images.
11. Segmentation using watershed transform.
12. Study of DICOM standards.
13. Medical Image Compression techniques.
14. Medical image fusion

COURSE OUTCOMES (COs)															
CO1	To understand the fundamentals of digital image and its properties														
CO2	To enhance the medical images by applying various filters														
CO3	To segment the region of interest using various image processing algorithms														
CO4	To study on DICOM standards														
CO5	To analyze different fusion techniques.														
CO6	To learn filtering methods														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			3	2	2		2					3	
	CO2		3	2						3					
	CO3	2			3		3				3				
	CO4			3		3		2		3		2			
	CO5		3	2			3				3	3	2		
	CO6	3			3	2	2		2						
3	Category	Professional Course (PC)													
4	Approval	48th Meeting of the Academic Council													

U18MCAB713	**BEHAVIORAL AND INTERPERSONAL SKILLS (NON-VERBAL SKILLS / BEHAVIOURS, NON-AGGRESSION)**	**L**	**T**	**P**	**C**
		0	0	2	0

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

- To help the students to understand their real self by recognizing different aspects of their self-concept that will lead to an increased self-confidence.
- To train the students for communicating effectively in both formal as well as in informal settings.
- To help the students to understand the importance of non-verbal aspects of effective communication.
- To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work
- To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.
- To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

- Motivational lectures
- Group Discussions/activities
- Case Study
- Games/Stimulation Exercises
- Role-Playing
- Mindfulness training.

U18MCAB714	NATURE CLUB	L	T	P	C
		0	0	2	0

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.
Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

- Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).
- Videography/ photography/ information collections on specialties/unique features of different types of common creatures.
- Search and explore patents and rights related to animals, trees etc.
  Studying miracles of mechanisms of different body systems.

U18EEBM8C1	COMPREHENSION	L	T	P	C
	Total Contact Hours : Test will be conducted at the end of the semester	0	0	0	1
	Prerequisite – All the courses up to seventh semester				
	Course Designed by – Dept of Biomedical Engineering				

OBJECTIVES

- To provide a complete review of Bio Medical Engineering topics covered up to fifth semesters, so that a comprehensive understanding is achieved.
- It will also help students to face job interviews, competitive examinations and also to enhance the employment potential.
- To provide overview of all topics covered and to assess the overall knowledge level up to fifth semester.

U18MCAB815	INNOVATION PROJECT BASED – SC., TECH, SOCIAL, DESIGN & INNOVATION	L	T	P	C
		0	0	2	0

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance.

PROFESSIONAL ELECTIVE

U18PEBM011	BIOFLUID AND BIOMECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Anatomy and Physiology				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- An understanding on the physiology and anatomy of studied systems,
- A capability to analyze cardiac, respiratory mechanics
- Explain about soft tissue and orthopedic mechanics

UNIT-I BIOMECHANICS 9

Newton's law, Stress, Strain, Hookes-law, Elasticity, Shear, Tension, Compression, Bone – Cancellous and cortical bone, structure, Mechanical Properties and mechanical testing of bone, UTM, creep and Fatigue.

UNIT II BIOFLUID MECHANICS 9

Viscosity, Newtonian fluid, Non-Newtonian fluid, Viscoelastic, Vascular tree, Flow properties of Blood, Physical, Chemical and Rheological properties of blood, Apparent and Relative and Viscosity, Problems associated with extra corporeal blood flow

UNIT-III BIOSOLID MECHANICS **9**

Constitutive equation of viscoelasticity –Maxwell &Voight models, anisotropy, Hard Tissues –Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Skeletal Muscle –Muscle action, Hill's models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT IV SOFT TISSUE MECHANICS **9**

Tissue Mechanics-Mechanical Properties of Tissues, Biological materials, Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons.

UNIT V ORTHOPAEDIC MECHANICS **9**

Mechanical properties of cartilage, diffusion properties of articular cartilage, kinetics and kinematics of joints, lubrication of joints analysis of force in orthopaedic implants. Biomechanics of Elbow Shoulder hip and Knee.

TEXT BOOK

1. Biofluid Mechanics,The Human Circulation, Second Edition,ByKrishnan B. Chandran, Stanley E. Rittgers, Ajit P. Yoganathan.

REFERENCES

1. Cyrul A Keele and Eric Neil – Samsons Wrights Applied physiology – Oxford University press New Delhi – 1991
2. Ranganathan
3. T S,Text Book of human Anatomy S. Chand and company New Delhi – 1994
4. Arthur.C.Guyton, John E Hall, "*Textbook of medical physiology*", W.B. Saunders Company, 11th edition, 2000.
5. Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh, "*Text book of human physiology*", S.Chand& Company, 5th edition, 2014.
6. Guyton 'Text book of Medical Physiology – WB Jaunder company Philadelphia - 10 edition 2002
7.

COURSE OUTCOMES (COs)	
CO1	Outline the fundamental concepts and definitions related to Biomechanics
CO2	Demonstrate the Cardiovascular and pulmonary system in human body
CO3	Identify the different blood properties, especially the anatomy and physiology of blood vessels.
CO4	Able to explain the laws concerning bio-fluid mechanics
CO5	Develop the model for orthopedic device
CO6	Explain the mechanism of human physiology

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	1		2	3		2	3	3	2		1		2
	CO2			2			3					3			
	CO3	2			3					3	2	1	1		
	CO4					3		3							
	CO5	3	3				1		2		3	2	1		

	CO6	3	1		2	3		2	3	3	2		1		
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM012	HUMAN ASSIST DEVICES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Medical Instrumentation-I				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To know the various Bio- potential recordings for enabling students to record various signals.
- To know the various functional blocks present in cardiac care units so that the students can handle these equipments with care and safety.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.
- To study the concept of various Human Assist Devices so as to enable the students to develop new devices with innovative technology.
- To introduce the recent trends in the field of Diagnostic and Therapeutic Equipments.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition for H/L System, Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

UNIT II CARDIAC ASSIST DEVICES 9

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthodic System, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthodic devices, Haptic Devices

UNIT V RESPIRATORY AND HEARING AIDS 9

Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters, Types of Deafness, Hearing Aids, Construction and Functional Characteristics.

TEXT BOOK

1. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.
2. Andreas.F.Vonracum, Hand book of bio material evalution, Mc-Millan publishers, 1980.

REFERENCES

1. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982
2. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
3. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.

COURSE OUTCOMES (COs)	
CO1	To Discuss about the working principle of Heart Lung Machine and Artificial Heart
CO2	To Able to categorize the different classes of Cardiac assist devices and its Applicatio
CO3	To Identify the suitable requirements for Haemodialysis and performance analysis of Dialysers
CO4	To Able to choose the suitable materials and model for Rehabilitation
CO5	To analyse the mechanism for Audiometer and the common Hearing aids
CO6	To Explain the mechanism of Human Assist Devices

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2		2	3		2	1			1			3
	CO2			2			1			1			1		
	CO3		1		3				2		2				
	CO4						2	3		2		2			
	CO5	3	2						2		3	3	2		
	CO6	3		3	2			3	2						
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM013	**MEDICAL INFORMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Medical Instrumentation				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn about the historical information of hospitality and recent trends in the Hospital information system.
- To know about the basic concepts of artificial intelligence and expert systems.
- To study the hospital management information systems and computer assisted patient education.

UNIT-I INTRODUCTION 9

Structure of Medical Informatics, Internet and Medicine, Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics, Medical Informatics, Bioinformatics

UNIT-II COMPUTERIZED PATIENT RECORD 9

History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology, Application server provider, Clinical information system, Computerized prescriptions for patients

UNIT-III COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGINING 9

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System, Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance

UNIT-IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro-computers and Artificial Neural Networks application, Expert system, General model of CMD, Computer-assisted decision support system, production rule, system cognitive model, semester networks, decisions analysis in clinical medicine, computers in the care of critically patients, computer assisted surgery, designing.

UNIT-V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine, Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics, Computer assisted patient education and health, Medical education and health care information.

TEXT BOOK:

1. R.D.Lele '"Computer in Medicine" Tata McGraw Hill, Newyork, 1999.

REFERENCES:

1. S.K.Chauhan "PC Organisation", S.K.Kataria and Sons, Delhi 2000.
2. Harold Sackamn "Bio Medical Information Technology", Academic Press, Newyork. http://www.springer.com/series/684

COURSE OUTCOMES (COs)															
CO1	To Infer the function of Hospital Information Systems														
CO2	To Develop the concepts of artificial intelligence and expert systems														
CO3	To Interpret the various concept of Hospital management and information system														
CO4	To Construct the 3 dimensional imaging and its applications.														
CO5	To Relate the various trends of medical informatics														
CO6	To organize the information technology in hospital														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3		2		3	2	1		2	
	CO2			2			2		2				1		
	CO3	2	3		3				2	2	2				
	CO4					3		3	1			2	3		
	CO5	3	2	3	3		2			1	3				
	CO6	3	3		2	3		2		3	2	1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM021	TROUBLESHOOTING OF MEDICAL INSTRUMENTS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Electronic Devices and Circuits				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To provide the knowledge of planning, designing and safety management in hospital services.
- To know the Fundamental Troubleshooting Testing Procedures.
- To understand the Fault Diagnosis in Analog & Digital Integrated Circuits.

UNIT I - FUNDAMENTAL TROUBLESHOOTING TESTING PROCEDURES 9

Equipment failure and its causes, Functional block diagram of a troubleshooting system, Troubleshooting process & fault finding aids, Troubleshooting techniques and their correction action, Testing of active and passive components: resistor,capacitor, inductor, BJT, JFET & MOSFET.

UNIT II - FAULT DIAGNOSIS IN ANALOG & DIGITAL INTEGRATED CIRCUITS 9

Characteristics of ideal op-amps, typical op-amp based medical circuits, Fault diagnosis in op-amp circuits, Digital troubleshooting methods, Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator, Circuit board Troubleshooting.

UNIT III - BIOMEDICAL EQUIPMENT TROUBLESHOOTING 9

Troubleshooting- ECG Machine, EEG Machine, defibrillator, electrosurgical unit, anesthesia machine, autoclaves & sterilizers, endoscope, incubators, nebulizer, oxygen concentrators, sphygmomanometers, suction machine, X-ray machine.

UNIT IV - MEDICAL DEVICE DESIGN QUALITY 9

Definition of quality, essence of quality, Quality operating system and the device life cycle, Evolution of quality, Business excellence: a value proposition, Health care quality.

UNIT V - DESIGN FOR SIX SIGMA AND MEDICAL DEVICE REGULATION 9

Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF), Medical device safety, medical device quality management systems requirements, Medical device regulation throughout the product development life cycle, Purpose of ISO 9001:2001&ISO 13485.

TEXT BOOKS:

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair & Maintenance", Tata McGraw Hill, 2nd Edition, 2009.
2. Basem S EL-Haik& Khalid S Mekki, "Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness", John Wiley & Sons, 1st Edition, 2008.

REFERENCES:

1. Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting for Biomedical Technicians", TSTC Publishing, 2nd Edition, 2010.
2. Dan Tomal& Neal Widmer, "Electronic Troubleshooting", McGraw Hill, 3rd Edition, 2004.

3. World Health Organisation, "Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment", Geneva, 1994.

COURSE OUTCOMES (COs)	
CO1	To Outline the trouble shooting basic procedure
CO2	To Infer the various analog and digital circuits trouble shooting procedures
CO3	To Apply the trouble shooting procedures to various biomedical equipments
CO4	To Develop the quality procedure for healthcare equipment
CO5	To Relate the various regulations for biomedical devices
CO6	To explain briefly about analog and digital integrated circuits

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2			3		2	1		2	1		3	
	CO2			2			1			1		3	3		
	CO3	2	1		3				2		2				
	CO4							3		2		2			
	CO5	3	2						2		3		1		
	CO6	3	2			3		2	1		2	1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM022	**REAL TIME PROCESSOR AND BIOMEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Microprocessor and Microcontroller in Biomedical Applications				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn about the Digital Signal Processing and BIOMEMS in the real time.
- To provide knowledge in PSOC
- To Know about working principle of MEMS and Microsystems

UNIT-I INTRODUCTION TO DIGITAL SIGNAL PROCESSING DEVICES 9

Architecture of TMS 320C54XX Digital Signal Processor-18. Addressing Modes and Instruction sets of TMS 320C54XX DSP-19. TMS 320VC5416 Assembly Language Programming-. Interfacing and Real Time C Programming with TMS 320C54XX- TMS 320C6713 Floating Point Processor Architecture and Real Time C Programming

UNIT-II PROGRAMMABLE EMBEDDED SYSTEM-ON-CHIP (PSOC) PROCESSOR 9

Architecture- Designer- Developing tools- biomedical applications

UNIT-III INTRODUCTION TO REAL-TIME IMAGING 9

Basic Hardware Architecture.-Linear Image Processing Algorithms-Compression by Matrix Transforms-Nonlinear Image Processing Algorithms-Parallel Architectures-Programming Languages-Optimization Techniques

UNIT IV MEMS AND MICROSYSTEMS 9

Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

UNIT V BIOMEMS 9

Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip.

TEXT BOOKS

1. Udayashankara, V. ,Real time digital signal processing : fundamentals, algorithms and implementation using tmsprocessor,phi 2007.
2. Edward R. Dougherty, Phillip A. Laplante ,Introduction to Real-Time Imaging ISBN: 978-0-8194-1789-3,February 1995, Wiley-IEEE Press.
3. Tai Ran Hsu , " MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002.

REFERENCES

1. Technical Reference Manuals,Cyprus Semiconductors,USA 2008.
2. https://nanohub.org/resources/992/download/2005.02.07-Bashir1.pdf

COURSE OUTCOMES (COs)	
CO1	To Infer the architectures of various processors and programming
CO2	To Develop the biomedical devices using PSOC
CO3	To Classify the various Nonlinear Image Processing Algorithms
CO4	To Interpret the working principle of Microsystems.
CO5	To Outline the applications of MEMS in biomedical field
CO6	To Able to Develop programming languages for image processing

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2		2	3		2	1		2				2
	CO2			2			1			1			1		
	CO3	2	1		3				2		2	1	2		
	CO4			3	1	3	2	3		2		2			
	CO5	3	2						2		3	3			
	CO6	3	2		2	3		2	1		2				
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM023	**CLINICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Health Hospital and Equipment Management				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To educate on the basic concepts of laboratory animal care and ethical requirements and to introduce the principles of biological standardization.
- To provide the basic knowledge in clinical trials
- To understand about phase of conducting clinical trials

UNIT I REGULATION FOR LABORATORY ANIMAL CARE AND ETHICAL REQUIREMENTS 9

Introduction to commonly used experimental animals and their limitations in biological screening. Guidelines for care and handling of laboratory animals CPCSEA (including IAEC), OECD, ICH, GLP and ICMR Guidelines. Proforma (s) for performing experiments on animals as per various guidelines. Maintenance and Breeding techniques for laboratory animals. Organization of screening: Pharmacological activity of new substances and safety assessment tests. Toxicity studies: acute, subacute (Repeated dose), subchronic and chronic toxicity.

UNIT II PRINCIPLES OF BIOLOGICAL STANDARDIZATION 9

Methods of biological assay, principles of biological assays, official bioassays of some important drugs (Digitalis, insulin, nor adrenaline and histamine).Modern Techniques and New Approaches in drug evaluations: Animal cell lines and their uses, Radiological and binding assay

UNIT III INTRODUCTION TO CLINICAL TRIALS 9

Glossary of terms in clinical trials, history, requirements, new drug development process, need for new drug, selection of a chemical compound as a potential drug, screening of chemical compounds, translation medicine, assessment of preclinical data, Goals of clinical trials- Target population and patient selection.

UNIT IV PHASES OF CLINICAL TRIALS AND LEGAL ISSUES IN CLINICAL TRIALS 9

Phase 1, Phase 2, Phase 3 studies, Phase 4,Drug regulations- National- good clinical practice and schedule Y, Critical evaluation of literature- Systematic review and meta analysis, evidence based medicine

UNIT V PROCESS OF CONDUCTING A CLINICAL TRIAL 9

Drug development ,The process of ethical approval ,pre-study organization, protocol design, case Report Form (CRF) design ,Informed consent ,ethics approval, monitoring & Source Data Verification (SDV) ,safety Assessment - Good Clinical Practice Guidelines (GCP) & adverse events ,essential documentation, audit & inspections.

TEXTBOOK

1 Friedman LM, Furberg CD, DeMets DL**.** *Fundamentals of Clinical Trials*. 4th ed. New York, NY: Springer; 2010.Additional Reading Parmigiani, G. (2002).
2 Modeling in Medical Decision Making: A Bayesian Approach, John Wiley and Sons.

REFERENCES

1. Shein-Chung Chow, Jen-Pei Liu, Design and Analysis of Clinical Trials: Concepts and Methodologies.
2. Eleanor McFadden (2007), Management of Data in Clinical Trials, Frontier Science , Ltd.
3. Susanne Prokscha (2011) Practical Guide to Clinical Data Management.
4. Richard K.Bondel, Sheila A.Varley, Colin F.Webb,(2000),Clinical Data Management, Second Edition, Wiley Publications.
5. John I. Gallin, Frederick P. Ognibene (2012), Principles and Practice of Clinical Research, Elsevier Publications.

COURSE OUTCOMES (COs)	
CO1	To Outline the various regulations and ethical requirements for animal care
CO2	To Infer the basics of principles of biological standardization
CO3	To List the drug development process
CO4	To Relate the phases of clinical trials and legal issues in clinical trials
CO5	To Build the process of conducting a clinical trial
CO6	To Design protocols for ethical acceptance

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2			2	3		2	
	CO2			2									1		
	CO3	2			3						2				
	CO4					3		3				2	1		
	CO5	3									3				
	CO6	3			2	3		2			2	3			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM031	NUCLEAR MEDICINE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Radiological Equipments				
	Course Designed by:-Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand the fundamentals of Nuclear Medicine and learn about the instruments involved in production techniques and therapeutic uses of Nuclear Medicine.
- To learn about various nuclear medicine instrumentation
- To educate radiation safety

UNIT I - BASICS OF NUCLEAR MEDICINE **9**

Radioactivity and interaction of radiation; Alpha, Beta and gamma emission, Laws of radioactive decay, Mechanisms of radioactive delay, Radiation intensity and exposure, Decay schemes and energy levels, Compton scattering, Pair productions, Particle interactions

UNIT II - RADIOPHARMACEUTICALS **9**

Radionuclide production, 99Mo/99mTc generator, Mechanism of localization, Types of radiopharmaceuticals, characteristics of radio pharmaceuticals, Radiopharmaceuticals for diagnosis and treatments in human, Dispensing of radio pharmaceuticals, RIA radiopharmaceuticals and kits production.

UNIT III - NUCLEAR MEDICINE INSTRUMENTATION **9**

Construction and principle operation of Gamma camera, Rectilinear scanner, Basic principles of pulse height analyser, Radiation detectors-Ionization chamber, Geiger Muller counter, Semiconductor detectors, Scintillation detectors, Electronic Instrumentation for radiation detection system,

UNIT IV - DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF RADIONUCLID **9**

PET-CT, Single photon emission computed tomography (SPECT), Radio iodine therapy for Thyrotoxicosis , Differentiated thyroid cancers, Palliative treatment for bone metastasis - 32P and 89 Strontium Dosage, Intravascular particulate radio nuclide Therapy, Receptor targeted therapy, 131I- MIBG Therapy, Targeted internal radiation in HCC: 90 Y, Radio-synovectomy using Yttrium

UNIT V - RADIATION SAFETY **9**

Radiation protection indifferent nuclear isotope therapy procedures, Management of radiation accidents, Radiation effect on pregnancy and fertility, Diagnosis, evaluation and treatment of radiation overexposure, Instruments used in radiation survey & monitoring, Handling of radioactive patients, Role of national and international bodies in radiation safety, ICRP recommendations, BARC regulations regarding limits of radiation exposure.

TEXTBOOKS

1. Simon Cherry, James Sorenson, Michael Phelps. "Physics in Nuclear Medicine", Elsevier Saunders , 4th Edition ,2012.
2. Jennifer Prekeges, "Nuclear Medicine Instrumentation", Jones and Barlett publishers, 1st edition, 2011.

REFERENCES

1. Max.H.Lombardi, "Radiation safety in Nuclear Medicine", CRC Press, Florida, USA, 2nd edition 1999.

COURSE OUTCOMES (COs)															
CO1	To Label the basics of nuclear medicine														
CO2	To Interpret the construction and principle of operation of various nuclear medicine Instruments.														
CO3	To Infer the characteristics and mechanisms of Radiopharmaceuticals														
CO4	To Identify the diagnostics and therapeutic applications of nuclear medicine.														
CO5	To List the radiation safety procedures and regulations.														
CO6	To recall about radiation safety precautions														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3		2	1		2	1			2
	CO2			2			1			1			1		
	CO3	3	1		3				2		2		2		
	CO4			3	1	3	2	3		2					
	CO5	3	3						2		3	3			
	CO6	3	3		2	3		2	1		2	L			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM032	MODELLING OF PHYSIOLOGICAL SYSTEM	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Bio-control System				
	Course Designed by:-Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To design the physiological systems
- To analyze about control system
- To learn about various human systems, frequency analysis and modelling of physiological control systems

UNIT I INTRODUCTION TO PHYSIOLOGICAL CONTROL SYSTEMS 9

Introduction to modeling methodology- need for models-approaches to modeling, simulation, model identification- model validation- Engineering control system versus physiological control system-generalized system properties.

UNIT II ANALYSIS OF CONTROL SYSTEM 9

Open loop versus closed loop - Determination of steady state operating point for simple model of muscle stretch reflex - Regulation of glucose-insulin - Chemical regulation of ventilation.

UNIT III HUMAN SYSTEMS 9

Respiratory system: Modeling oxygen uptake by RBC and pulmonary capillaries, mass balancing by lungs, gas transport mechanism of lungs, oxygen and carbon dioxide transport in blood and tissues.

UNIT IV FREQUENCY ANALYSIS 9

Frequency response analysis – response to sinusoidal inputs – Closed loop and open loop response – Relationship between transient and frequency response – Graphical representation of Frequency response – Pupillary Retinal system .

UNIT V MODELING PHYSIOLOGICAL CONTROL SYSTEM 9

Identification of physiological control systems – Parametric and non-parametric identification methods – Identification of closed loop systems – minimal model of blood glucose regulation – Model based approaches – Neural network for control systems

TEXT BOOKS:

1. Advanced Methods of Physiological System Modelingby V.Z. Marmarelis
2. Applied mathematical model in Human Physiology, by Johnny T. Ottesen, Mette S. Olufsen, Jesper K.Larsen.

REFERENCE BOOKS:

1. Physiological basis of Ventilatory Support, By John. J. Marini, Arthur S. Slutsky
2. Pharmacokinetic and Pharmaco dynamic Data Analysis: Concepts and Applications**,** By Daniel (Weiner, Johan Gabrielsson).
3. http://physiology.arizona.edu/people/secomb/472-572lecturenotes09

COURSE OUTCOMES (COs)	
CO1	To Extend Knowledge about the physiological process in the biological system

CO2	To Compare the open and closed loop system with physiological system
CO3	To Interpret the working of various physiological
CO4	To Develop the frequency response analysis of Pupillary Retinal system
CO5	To Modelling of various physiological control system
CO6	To explain about gas transportation mechanism

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			1	2			2			3		2	
	CO2		1	2			3	3		3	2		1		
	CO3	2			3				3				3		
	CO4		2			3		2		2	3	2			
	CO5	2		2			2								
	CO6	3			1	2			2			3			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM033	**TISSUE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biomaterials and artificial organs				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand about the different types of tissues.
- To illustrate the aspects of cell culture.
- To illustrate the molecular aspects and biomaterials for tissue engineering.
- To analyze the case study and regulatory issues in tissue engineering.

UNIT I INTRODUCTION 9

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II CELL CULTURE 9

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspects of cell Culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III MOLECULAR BIOLOGY ASPECTS 9

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

UNIT IV SCAFFOLD AND TRANSPLANT 9

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, hepatopoiesis.

UNIT-V CASE STUDY AND REGULATORY ISSUES 9

Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK:

1. Robat Lanza and Robert Langer, **"Principles of Tissue Engineering"**, Elsevier, 2007.

REFERENCES:

1. Bernhard O. Palsson, Sangeeta N. Bhatia, **"Tissue Engineering"**, Pearson Publishers2009.

2. Ed. Joseph D. Bronzino, **"The Biomedical Engineering Hand Book"**, Second Edition, CRC Press LLC,200

COURSE OUTCOMES (COs)	
CO1	To Infer the structure and organization of tissues.
CO2	To List the different cell types and aspects of cell culture.
CO3	To Analyze the molecular aspects in tissue engineering
CO4	To List the types of biomaterials used for development of tissue
CO5	To Interpret the different case studies of physiological modeling
CO6	To Design biocompatible materials for organ transplant

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2		2	3		2	1		2	1		2	
	CO2			2			1			1					
	CO3	2	1		3				2		2				
	CO4			3	1	3	2	3		2					
	CO5	3	2						2		3	3	2		
	CO6	3	2		2	3		2	1		2	1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM041	**NEURAL NETWORKS AND PATTERN RECOGNITION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Digital and Medical Image Processing				
	Course Coordinator Name & Department:- Ms.Vinodhini R. & Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- This course makes the students to understand the neurological systems and some simple neural networks.
- To understand the types of neural networks and its applications.
- To provide the knowledge about pattern recognition and classification

UNIT I INTRODUCTION AND SIMPLE NEURAL NET 9

Elementary neurophysiology and biological neural network-Artificial neural network – Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT II BACK PROPOGATION AND ASSOCIATIVE MEMORY 9

Back propogation network, generalized delta rule, Bidirectional Associative memory, Hopefield network

UNIT III NEURAL NETWORKS BASED ON COMPETITION 9

Kohonen Self organising map, Learning Vector Quantisation, counter propogation network.

UNIT IV UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9

Patterns and features, training and learning in pattern recognition, discriminant functions, different types of pattern recognition. Unsupervised learning- hierarchical clustering, partitional clustering. Neural pattern recognition approach – perceptron model 58

UNIT V SUPERVISED LEARNING USING PARAMETRIC AND NON PARAMETRIC APPROACH 9

Bayesian classifier, non parametric density estimation, histograms, kernels, window estimators, k-nearest neighbour classifier, estimation of error rates.

TEXT BOOKS

1. Hagan, Demuth and Beale, “Neural network design”, Vikas Publishing House Pvt. Ltd., New Delhi , 2002
2. Freeman J.A., and Skapura B.M, " Neural networks, algorithms, applications and programming techniques”, Addison – Wesley,2003
3. Duda R.O, Hart P.G, “Pattern classification and scene analysis”, Wiley Edition,2000
4. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 1999.

REFERENCES:

1. Robert Schalkoff, “ Pattern recognition, Statistical, Structural and neural approaches” John Wiley and Sons(Asia) Pte. Ltd., Singapore, 2005
2. LaureneFausett ,” Fundamentals of neural networks – Architectures, algorithms and applications”, Prentice Hall, 1994.

COURSE OUTCOMES (COs)	
CO1	To Outline the fundamentals of neurophysiology
CO2	To List the various artificial neural network
CO3	To Infer about the Self organizing maps and competitive networks
CO4	To Recall the fundamentals of pattern recognition
CO5	To Classify the different supervised learning algorithm
CO6	To Differentiate unrecognized and recognized data

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3					1					2		3	
	CO2	3	2		2					3			2		
	CO3	3		2		2	2		2				2		

	CO4	3	1	2		1		1			2		2		
	CO5	1				2	1	2					2		
	CO6	3					1					2			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM042	REHABILITATION ENGINEERING	L	T	P	C
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite course –Biomaterials and artificial organs				
	Course Coordinator Name & Department:- Ms.Geetha S. & Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand the rehabilitation concepts.
- To understand the Engineering Concepts of Sensory & Motor rehabilitation.
- To study different types of Therapeutic Exercise Techniques.
- To Understand the different types Hearing aids, visual aids and their application in biomedical field.
- To study the various orthotic devices and prosthetic devices to overcome orthopedic problems.

UNIT-I INTRODUCTION TO REHABILITATION 9

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

U**NIT-II PRINCIPLES OF REHABILITATION 9**

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering-Key Engineering Principles, Key Ergonomic Principles -Practice of Rehabilitation and Assistive Technology.

UNIT III THERAPEUTIC EXERCISE TECHNIQUE 9

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercise-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

UNIT IV MANAGEMENT OF COMMUNICATION 9

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.

UNIT V ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES 9

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers-FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics; Myoelectric controlled prosthetics and Externally

powered limb prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems(HAS).

TEXT BOOKS:

1. Sunder, "Textbook of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007
2. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third Edition-3 volume set, Taylor & Francis,2006.

REFERENCES:

1. Horia-NocholaiTeodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December2000.
2. Keswick. J., "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation", Springer-Verlag, New York, 1982.
3. Warren E. Finn,Peter G. LoPresti, "Handbook of Neuroprosthetic Methods", CRC; Edition2002.
4. Rory A Cooper (Editor), HisaichiOhnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering", CRC Press,2006.

COURSE OUTCOMES (COs)	
CO1	To Outline the rehabilitation concepts.
CO2	To Label the principles of rehabilitation.
CO3	To Compare the types of therapeutic exercise techniques.
CO4	To Extend the knowledge in different communication management
CO5	To Outline the various orthotic devices and prosthetic devices to overcome orthopedic problems.
CO6	To design orthopedic devices

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	3		2	3	3	2			2	1		2	
	CO2			2					2	2			1		
	CO3	2			3		3			3	2				
	CO4		2			3		3	2			2			
	CO5	3					3			3	3	3	2		
	CO6	3	3		2	3	3	2			2	1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM043	**BRAIN CONTROL INTERFACE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Biosensors and Measurements				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To discuss the radiation therapy techniques and radiation safety

UNIT-I INTRODUCTION TO BRAIN CONTROL INTERFACE FUNDAMENTALS OF BCI 9

Structure of BCI system – Classification of BCI: Invasive, Non-invasive and Partially invasive BCI Brain signal acquisition, Signal Preprocessing, Artifacts removal .

UNIT-II ELECTROPHYSIOLOGICAL SOURCES SENSORIMOTOR ACTIVITY 9

Neuronal activity in motor cortex and related areas- Electric and magnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm, Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms

UNIT-III FEATURE EXTRACTION METHODS TIME/SPACE METHODS 9

Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features

UNIT-IV FEATURE TRANSLATION METHODS LINEAR DISCRIMINANT ANALYSIS 9

Nearest neighbours, Support Vector Machines - Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks

UNIT-V APPLICATIONS OF BCI 9

Dataset I, II, III, IV and V, Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device controllers.

TEXT BOOKS

1. Jonathan Wolpaw,Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012.

REFERENCE BOOKS

1. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
2. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
3. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
4. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch," A survey ofsignal Processing algorithms in brain–computer interfaces based on electrical brain signals" JOURNAL OF NEURAL ENGINEERING, VOL.4, 2007, PP.32-57

COURSE OUTCOMES (COs)	
CO1	To Outline the fundamentals of brain control interface
CO2	To Interpret the different measuring parameters of EEG
CO3	To Recall the various feature extraction methods
CO4	To Infer about the feature translational methods
CO5	To Extend about the BCI applications
CO6	To Explains about functional datasets

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2	3		2			3	

	CO2			2			2			3					
	CO3	2	3		3				2		2				
	CO4					3	1	3		2		2	2		
	CO5	3	1		2				1		3	3	2		
	CO6	3			2	3		2	3		2				
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM051	BIOPROCESS TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Biochemistry				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce Bioprocess Technology and Enzyme based actions in Medical Applications
- To understand the bioreactors design
- To learn about bioprocess estimation

UNIT I INTRODUCTION OF BIOPROCESS TECHNOLOGY 9

Introduction to bioprocess technology, Screening, preservation and improvement of industrially important microorganisms, Raw material and media formulation for fermentation process, Influence of environmental factors on growth and product formation.

UNIT II BIOREACTORS 9

Bioreactor design.Batch, fed batch and continuous cultivation.Solid state cultivation.Sterilization of media reactor and air.Agitation and aeration and mass transfer of oxygen.Inoculum development, addition and sampling.

UNIT III GROWTH RATE ANALYSIS 9

Growth rate parameters : Specific growth rate, doubling time, validity of exponential growth law, growth yield, metabolic quotient, Effect of substrate concentration, Monod Kinetics, Determination of Ks, Definition of lag period.

UNIT IV ENZYME TECHNOLOGY 9

Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation, basic design and configuration of immobilised enzyme reactors, applications of immobilised enzyme technology.

UNIT V BIOPROCESS ESTIMATIONS 9

Methods of on-line and off-line biomass estimation; Flow injection analysis for measurement of substrates.Product and other metabolites; State and parameter estimation techniques for biochemical processes; Computer-based data acquisition, monitoring and control-LABVIEW Software.

TEXT BOOK

1. Principles of Fermentation Technology : Whitekar&Stanbury
2. Industrial Microbiology – Casida.

REFERENCE BOOKS

1. Shule and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
http://www.slideshare.net/yongkangbirdnest/lecture-5-bioprocess-technology-operation-mode-and-scale

COURSE OUTCOMES (COs)	
CO1	To Recall the basic principle of bioprocess
CO2	To Demonstrate the Bioreactor design, Batch, fed batch and continuous cultivation
CO3	To Extend the knowledge in growth rate parameters
CO4	To Outline the fundamentals of enzyme technology
CO5	To Recall about Methods of biomass estimation
CO6	Recalls configuration of immobilization enzyme reactors

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3		2	1		2			2	
	CO2			2			1			1		2	1		
	CO3		1		3				2		2				
	CO4			3		3		3				3			
	CO5	3	2						2		3	3			
	CO6	3			2	3		2	1		2				
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM052	**VLSI DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Analog and Digital IC's				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce NMOS, PMOS, CMOS devices and their characteristics
- To design principles, design layout rules, construction of multiplexers
- To gain the knowledge in Verilog HDL

UNIT I : MOS TRANSISTOR THEORY AND PROCESS TECHNOLOGY 9

NMOS and PMOS transistors - Threshold voltage - Body effect - Design equations - Second order effects -MOS models and small signal AC characteristics - Basic CMOS technology.

UNIT II: INVERTERS AND LOGIC GATES 9

NMOS and CMOS Inverters - Stick diagram - Inverter ratio - DC and transient characteristics –switching times - Super buffers - Driving large capacitance loads - CMOS logic structures - Transmission gates -Static CMOS design - Dynamic CMOS design.

UNIT III: CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 9

Resistance estimation - Capacitance estimation - Inductance - Switching characteristics – Transistor sizing- Power dissipation and design margining - Charge sharing - Scaling.

UNIT IV: VLSI SYSTEM COMPONENTS CIRCUITS 9

Multiplexers - Decoders - comparators - Priority encoders - Shift registers - Arithmetic circuits -Ripple carry adders - Carry look ahead adders - High-speed adders - Multipliers- Physical design -Delay modelling -Cross talk - Floor planning - Power distribution - Clock distribution - Basics of CMOS testing.

UNIT V: VERILOG HARDWARE DESCRIPTION LANGUAGE 9

Overview of digital design with Verilog HDL - Hierarchical modeling concepts - Modules and port definitions- Gate level modeling - Data flow modeling – Behavioralmodeling - Task & functions -Test Bench.

TEXT BOOK

1. Subbaram N.R. " Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

REFERENCES

1. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.
2. Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.html

COURSE OUTCOMES (COs)	
CO1	To Understand the characteristics of different metal oxide semiconductor
CO2	To Interpret the knowledge in working principle of inverters and logic gates
CO3	To Understand the performance characteristics of transistor
CO4	To Relate the different circuits used in VLSI system
CO5	To Understand the VHDL model for combinational networks
CO6	To recall Hierarchical modeling concepts

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3			2	3	2	2	3		2				3
	CO2		3	2						3		3			
	CO3	2			3		3		2		2		2		
	CO4		2			3		3		3		3			
	CO5	3		1							3	3			
	CO6	3			2	3	2	2	3		2				
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM053	**VIRTUAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Digital and Medical Image Processing				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To introduce Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data flow techniques.
- To study CAN bus characteristics. Bus interface for R8422 and RS485.

- To study Principles of PAL's PLD's GAL's CPLD and their design considerations.
- To study Principles and design considerations of specific PROM, EPROM, SRAM, SDRAM. Dual ported memories, FIFO's flash memories
- To study Multiphase clock generators, LCD display controller.

UNIT-1: REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data flow techniques. Graphical programming in data flow, comparison with conventional programming.

UNIT-2 : VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES 9

VIS and subVIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT-3: DATA ACQUISITION BASICS 9

ADC, DAC, DIO, counters and timers. PC hardware structure, timing, interrupts, DMA, software and hardware installation.

UNIT-4: COMMON INSTRUMENT INTERFACES 9

Current loop, RS232C/RS485, GPIB, system buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI etc., networking basics for office and industrial applications, visa and IVI, image acquisition and processing, motion control.

UNIT-5: USE OF ANALYSIS TOOLS 9

Fourier transforms, power spectrum correlation methods, windowing uttering, VI application in various fields.

TEXTBOOKS

1. Anand M M S, Electronic Instruments and Instrumentation Technology, PHI Publishers, 2007.
2. Stephen Bennett, Emagic Logic Virtual Instruments, PC Publishing, 2003.

REFERENCES:

1. http://ocw.njit.edu/csla/opse/opse-310/index.php

COURSE OUTCOMES (COs)	
CO1	To Understand the review of virtual instrumentation
CO2	To Outline the programming techniques for virtual instrumentation
CO3	To Infer the basics of data acquisition
CO4	To List the various interfaces and its applications
CO5	To Relate the analysis tools and its use
CO6	To Recall programming techniques

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3	2		2	3		2			2	1			2
	CO2			2			2		3	3			1		
	CO3	2	3		3	1					2				
	CO4			2	3	3	1	3	2	2		2			
	CO5	3	1	2				3	1		3	3	2		

	CO6	3	2		2	3		2			2	1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM061	BIOLOGICAL EFFECTS OF RADIATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Radiological Equipments				
	Course Coordinator Name & Department:- Dr.Vasuki R & Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn about the effects of Radiation in living cells
- To know about the Genetic effects of Radiation
- To study about Microwave, RF and UV radiation
- To acquire knowledge about Ionising and Non- ionising Radiation

UNIT – I ACTION OF RADIATION IN LIVING CELLS **9**

Various theories related to radiation at cellular level. DNA and chromosomal damages.

UNIT – II SOMATIC APPLICATION OF RADIATION **9**

Radio sensitivity protocols of different tissues of human. LD50/30 effective radiation on skin, Bone marrow, eye, endocrine glands, and basis of radio therapy.

UNIT – III GENETIC EFFECTS OF RADIATION **9**

Threshold and linear dose, gene control hereditary diseases effect of dose.

UNIT – IV EFFECT OF MICROWAVE AND RF WITH MATTERS **9**

Effects of various human organs and systems, Wavelength in tissue, non thermal interaction Standards of protection, national, and international standards and precautions.

UNIT – V UV RADIATION **9**

Classification of sources, measurement, photo medicine, UV radiation, safety visible and infrared Radiation.

TEXTBOOK

1. Paul Fryer, Duncan Ward, Radiation, White Cube Publishers (2008).

REFERENCE

1. SteveForshier, Essential of Radiation Biology and Protection, Delmar Publishers (2008).
2.

COURSE OUTCOMES (COs)	
CO1	To Understand the Theories related to Radiation in the living cell.
CO2	To Recall the Somatic application of Radiation.
CO3	To Understand the Genetic effects of Radiation
CO4	To Infer the effect of Microwave and RF with human organs
CO5	To Outline the sources of UV radiation and methods to protect from this Radiation
CO6	To learn International Standards and Precautions

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3		2			3		1		2	2		2	
	CO2		3		2	3		3		3		2			
	CO3	2				3	3		2		3		1		
	CO4			2	3	2	3					2			
	CO5					1	2	2		3	2	3			
	CO6	3		2			3		1		2	2			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM062	**BIOMEDICAL LASER INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Semiconductor Physics				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand the fundamentals optical properties of of laser,
- To know the operations of laser and types of laser.
- To gain the knowledge of applications in medical field.

UNIT I - OPTICAL PROPERTIES OF TISSUES **9**

Scattering- Absorption- Refractive Index - Light transport inside the tissue - Interaction of light with matter - quantum behavior of light - Light interaction with tissues - Optothermal interaction – Fluorescence Speckles

UNIT II - BASIC THEORY OF LASER **9**

LASER action : stimulated & spontaneous emission- Molecular energy level - characteristics of laser- population inversion - Pumping methods and levels of pumping- Optical cavity configurations –Amplification - Optical resonator and gain - Q-switching - Mode locking- LASER modes - Line broadening

UNIT III - TYPES OF LASER **9**

Solid state, Ruby, Nd:YAG, Tunable solid state, Alexandrite, Titanium-sapphire Gas lasers: Helium-Neon, Argon, Co2 - Tunable dye – Semiconductor

UNIT IV - HOLOGRAPHY AND ITS MEDICAL APPLICATIONS **9**

Holography – Basic principle- methods of Holographic interferometry – applications - Holography for non-destructive testing –applications of LASER holography in medicine: Dentistry, Ophthalmology, Otology, Orthopedics.

UNIT V - MEDICAL APPLICATIONS OF LASER **9**

Photo-chemical interaction- Thermal interaction- Photoablation - Plasma induced ablation – photo-disruption- Applications: Ophthalmology, Dentistry, Urology, Neurosurgery, Dermatology, Orthopedics, Angioplasty, Cardiology, and Surgery- Diffused optical tomography.

TEXTBOOKS

1. Thyagarajan K, Ajoy K, Ghatak A, "Lasers Fundamentals and Applications", Second edition, Springer 2010.
2. Markolf H. Niemz, "Laser-Tissue Interactions: Fundamentals and Applications", Third edition, Springer 2007.

TEXT BOOKS

1. Keiser, "Optical Fiber Communication Systems", McGraw Hill Ltd., Thirdedition, 1983.

REFERENCES

1. John E, Harry, "Industrial lasers and their applications", Second edition,McGraw Hill, 1974.
2. John F Ready, "Industrial applications of lasers", Second edition, AcademicPress, 1978

COURSE OUTCOMES (COs)	
CO1	To Understand the concept of optical properties of tissue
CO2	To Illustrate the laser action and the characteristics of laser
CO3	To List applications of lasers in medical field
CO4	To Outline the holography and its applications
CO5	To Relate the applications of laser in medical field
CO6	To study holography applications in medicine field

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3				3	3	1				1			3
	CO2		2		2					3			3		
	CO3	2				3	2		2		3	2			
	CO4			2	3					1		1			
	CO5					3		2					2		
	CO6	3				3	3	1				1			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

U18PEBM063	**BIOPHOTONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Medical Physics				
	Course Designed by:- Department of Biomedical Engineering				

COURSE OBJECTIVES:-

- To impart adequate knowledge on various optical systems used in sensing and Imaging of biological elements.
- To know the principle of bio imaging
- To understand the various optical biosensors

UNIT I - LIGHT - MATTER INTERACTION & PRINCIPLE OF OPTICS 9

Light matter interaction: Interaction of light with bulk matter- Types of spectroscopy: Electronic absorption-, Electronic luminescence-, Vibration-, and Fluorescence-spectroscopy.

UNIT II - BIO-IMAGING: PRINCIPLES AND TECHNIQUES 9

Introduction of optical imaging, Types of microscopy: Transmission-, Fluorescence-, Scanning- and Multi-photon- microscopy- Advantages and disadvantages of optical imaging- Applications of optical imaging

UNIT III - OPTICAL BIOSENSORS 9

Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic-, Planar waveguide-, Evanescent-, Interferometric-, and Surface plasmon resonance- biosensor- Advantages and disadvantages- Applications

UNIT IV - FLOW CYTOMETRY 9

Flow cytometry: Basis, Components, and Flourochromes- Data manipulation and presentation

UNIT V - PHOTODYNAMIC THERAPY 9

Photodynamic therapy: Mechanism, and light irradiation- Photo-hemotheraphy- PUVA Technique- Applications.

TEXTBOOKS

1. Jurgen Popp, Valery V, Techin, Arthur Chiou, Stefen Heinemann, "Handbook of BiophotonicsVol 2: Photonics for Health Care", John Wiley & Sons, FirstEdition, 2012.
2. Paras N, Prasad, "Introduction to Biophotonics", John Wiley & Sons, First Edition, 2003.

REFERENCES

1. Harold Sackman, Brian Wilson, ValeriViktorovichTuchin, S. Tanev,HaroldSackman "Advances in Biophotonics", IOS Press, 2005.
2. Paras N Prasad, "Nanophotonics", John Wiley & Sons, First Edition, 2004

COURSE OUTCOMES (COs)															
CO1	To Understand the various interaction mechanisms of light with matter.														
CO2	To Infer the working principles of optical imaging systems.														
CO3	To List the various sensors used in biosensors														
CO4	To Understand the basic concepts of cytometer														
CO5	To Outline the importance of phototherapy in treatment of diseases														
CO6	To study about applications of optical biosensors														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PS02**
2	CO1	3					3					2			2
	CO2		3		2			3		3			2		
	CO3	2				2			2		3		2		
	CO4			2	3	3				2		3			
	CO5							2	3			3			
	CO6	3					3					2			
3	Category	Professional Course (PC)													
4	Approval	49th Meeting of the Academic Council													

CURRICULUM AND SYLABUS (R2018)

B – FACT: Flexible Accommodative choice based credit system for Technology

(Applicable to the batches admitted from July 2018)

B.Tech – CIVIL ENGINEERING - FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl.No	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	4	0	0	4
3	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
8	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
9	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
10	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	**35**	**16**	**0**	**19**	**20.5**

SEMESTER II								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics-II	4	4	0	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
PRACTICAL								

7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	**36**	**18**	**1**	**17**	**25.5**

SEMESTER III								
Sl. No.	**Course Code**	**Category**	**Course Title Theory**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA306	BS	Transform &Partial Differential Equations	3	2	1	0	3
2	U18ESCE301	ES	Computer-aided Civil Engineering Drawing	2	2	0	0	2
3	U18ESME301	ES	Engineering Mechanics	4	3	1	0	4
4	U18PCCE301	PC	Engineering Geology	2	2	0	0	2
5	U18PCCE302	PC	Construction Technology	3	3	0	0	3
6	U18PCCE303	PC	Introduction to Civil Engineering	3	3	0	0	3
7	U18PCCE304	PC	Surveying & Geomatics	2	1	1	0	2
PRACTICAL								
8	U18ESCE3L1	ES	Computer aided Civil Engineering DrawingLaboratory	2	0	0	2	1
9	U18PCCE3L2	PC	Surveying & GeomaticsLaboratory	2	0	0	2	1
10	U18PCCE3L3	PC	Engineering Geology Laboratory	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
12	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	**29**	**16**	**3**	**10**	**22**

SEMESTER IV								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA402	BS	Probability, Statistics & Numerical Methods	4	3	1	0	4
2	U18PCCE401	PC	Reinforced Concrete Design	3	3	0	0	3
3	U18PCCE402	PC	Introduction to Fluid Mechanics	2	2	0	0	2
4	U18PCCE403	PC	Introduction to Solid Mechanics	2	2	0	0	2
5	U18PCCE404	PC	Building Materials & Testing Methods	2	1	1	0	2
6	U18PCCE405	PC	Geotechnical Engineering	2	2	0	0	2
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
8	U18PCCE4L1	PC	Geotechnical Engineering Laboratory	2	0	0	2	1
9	U18PCCE4L2	PC	Fluid Mechanics Laboratory	2	0	0	2	1
10	U18PCCE4L3	PC	Building Materials & Testing Laboratory	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media –Group Reading of Classics	2	0	0	2	0
Total				**27**	**15**	**2**	**10**	**18**

SEMESTER V								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCCE501	PC	Structural Analysis-I	3	3	0	0	3
2	U18PCCE502	PC	Hydraulic Engineering	3	3	0	0	3
3	U18PCCE503	PC	Foundation Engineering	3	3	0	0	3
4	U18PCCE504	PC	Hydrology and Water Resources Engineering	3	3	0	0	3
5	U18PCCE505	PC	Environmental Engineering	3	3	0	0	3
6	U18PECE5E1	PE	Professional Elective-I	3	3	0	0	3
7	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
8	U18MCTH502	MC	Universal Human Values	2	2	0	0	0

PRACTICAL								
9	U18PCCE5L1	PC	Hydraulic Engineering Laboratory	2	0	0	2	1
10	U18PCCE5L2	PC	Environmental Engineering Laboratory	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	**31**	**23**	**0**	**8**	**23**

SEMESTER VI								
Sl. No.	**Course Code**	**Category**	**Course Title Theory**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCCE601	PC	Structural Analysis-II	**3**	**3**	**0**	**0**	**3**
2	U18PCCE602	PC	Estimation & Costing	3	2	1	0	3
3	U18PCCE603	PC	Physico-Chemical Processes for Water and Wastewater Treatment	3	3	0	0	3
4	U18PCCE604	PC	Design of Steel Structures	3	3	0	0	3
5		PE	Professional Elective-II	3	3	0	0	3
6		PE	Professional Elective-III	3	3	0	0	3
7		OE	Open Elective-I	3	3	0	0	3
8	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
9	U18PCCE6L1	PC	Estimation & Costing Laboratory	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB611	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB612	MC	Social Services – NSS	2	0	0	2	0
			Total	**29**	**22**	**1**	**6**	**22**

SEMESTER VII								
Sl. No.	**Course Code**	**Category**	**Course Title Theory**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCCE701	PC	Disaster Preparedness & Planning Management	3	3	0	0	3
2	U18PCCE702	PC	Professional Practice, Law & Ethics	2	2	0	0	2
3	U18PCCE703	PC	Transportation Engineering	2	2	0	0	2
4		PE	Professional Elective-IV	3	3	0	0	3
5		PE	Professional Elective V	3	3	0	0	3
6		OE	Open Elective-II	3	3	0	0	3
PRACTICAL								
7	U18PCCE7P1	EE	Project-1 (Mini-project)	6	0	0	6	3
8	U18PCCE0T1	EE	Term paper	2	0	0	2	1
9	U18PCCE0C1	EE	Comprehension	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	**30**	**16**	**0**	**14**	**21**

SEMESTER VIII								
Sl. No.	**Course Code**	**Category**	**Course Title Theory**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective VI	3	3	0	0	3
2		PE	Professional Elective VII	3	3	0	0	3
4		OE	Open Elective-III (MOOC course)	2	2	0	0	2
PRACTICAL								
5	U18PCCE8P2	EE	Project-2	18	0	0	18	9
ACTIVITY BASED COURSES								
6	U18MCAB815	MC	Innovation–Project based– Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	**28**	**8**	**0**	**20**	**17**

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	**20.5**	**25.5**	**22**	**18**	**23**	**22**	**21**	**17**	**169**

LIST OF PROFESSIONAL ELECTIVE COURSES

PROFESSIONAL ELECTIVE –I (PE –I)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1.	U18PECE011	Transportation Engineering	Infrastructure planning and design	3	0	0	3
2.	U18PECE012	Construction Engineering & Management	Repairs and Rehabilitation of Structures	3	0	0	3
3.	U18PECE013	Environmental Engineering	Rural Water Supply and Onsite Sanitation System.	3	0	0	3
4.	U18PECE014	Hydraulic Engineering	Environmental Fluid Mechanics	3	0	0	3
5.	U18PECE015	Hydraulic Engineering	Design of Hydraulic Structures/Irrigation Engineering.	3	0	0	3
6.	U18PECE016	Structural engineering	Concrete Technology	3	0	0	3
7.	U18PECE017	Geotechnical Engineering	Advanced Soil Mechanics	3	0	0	3
8.	U18PECE018	Transportation Engineering	Geometric Design of Highways	3	0	0	3

PROFESSIONAL ELECTIVE –II (PE –II)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1	U18PECE021	Transportation Engineering	Urban Transportation & Planning	3	0	0	3
2	U18PECE022	Construction Engineering & Management	Construction Cost Analysis	3	0	0	3
3	U18PECE023	Environmental Engineering	Transport of Water and Wastewater	3	0	0	3
4	U18PECE024	Hydraulic Engineering	Open Channel flow	3	0	0	3
5	U18PECE025	Hydrology & Water Resources Engineering	Ground Water Engineering	3	0	0	3
6	U18PECE026	Structural engineering	Design of Concrete Structures	3	0	0	3
7	U18PECE027	Geotechnical Engineering	Ground Improvement Techniques	3	0	0	3
8	U18PECE028	Transportation Engineering	Public Transportation Systems	3	0	0	3

PROFESSIONAL ELECTIVE –III (PE-III)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1.	U18PECE031	Transportation Engineering	Remote Sensing & GIS	3	0	0	3
2.	U18PECE032	Construction Engineering & Management	Construction Productivity	3	0	0	3
3.	U18PECE033	Environmental Engineering	Biological Process for Contaminant Removal	3	0	0	3

4.	U18PECE034	Hydraulic Engineering	Surface Hydrology	3	0	0	3
5.	U18PECE035	Hydrology & Water Resources Engineering	Remote Sensing and GIS for Hydrology and Water Resource Management	3	0	0	3
6.	U18PECE036	Structural engineering	Pre stressed Concrete	3	0	0	3
7.	U18PECE037	Geotechnical Engineering	Geotechnical Design	3	0	0	3
8.	U18PECE038	Construction Engineering & Management	Construction Equipment & Automation	3	0	0	3

PROFESSIONAL ELECTIVE –IV (PE –IV)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1.	U18PECE041	Transportation Engineering	Traffic Engineering and Management	3	0	0	3
2.	U18PECE042	Construction Engineering & Management	Sustainable Construction Methods	3	0	0	3
3.	U18PECE043	Environmental Engineering	Solid and Hazardous Waste Management	3	0	0	3
4.	U18PECE044	Hydraulic Engineering	Pipeline Engineering	3	0	0	3
5.	U18PECE045	Hydrology & Water Resources Engineering	Urban Hydrology and Hydraulics	3	0	0	3
6.	U18PECE046	Structural engineering	Metal Structure Behaviors	3	0	0	3
7.	U18PECE047	Structural engineering	Industrial Structures	3	0	0	3
8.	U18PECE048	Geotechnical Engineering	Environmental Geo-technology	3	0	0	3

PROFESSIONAL ELECTIVE –V (PE –V)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1	U18PECE051	Transportation Engineering	Pavement Design	3	0	0	3
2	U18PECE052	Construction Engineering & Management	Construction Engineering Materials	3	0	0	3
3	U18PECE053	Environmental Engineering	Air and Noise Pollution and Control	3	0	0	3
4	U18PECE054	Hydraulic Engineering	Transient in closed conduits	3	0	0	3
5	U18PECE055	Environmental Engineering	Water & Waste water Treatment	3	0	0	3
6	U18PECE056	Structural engineering	Earthquake Engineering	3	0	0	3
7	U18PECE057	Geotechnical Engineering	Rock Mechanics	3	0	0	3
8	U18PECE058	Structural engineering	Structural Dynamics	3	0	0	3

PROFESSIONAL ELECTIVE –VI (PE –VI)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1.	U18PECE061	Transportation Engineering	Railway Engineering	3	0	0	3
2.	U18PECE062	Construction Engineering & Management	Construction Project Planning and Systems	3	0	0	3
3.	U18PECE063	Environmental Engineering	Environmental Impact Assessment and Life Cycle Analyses	3	0	0	3
4.	U18PECE064	Hydraulic Engineering	Basics of Computational Hydraulics	3	0	0	3
5.	U18PECE065	Hydraulic Engineering	River Engineering	3	0	0	3
6.	U18PECE066	Structural engineering	Engineering Materials for sustainability	3	0	0	3
7.	U18PECE067	Geotechnical Engineering	Offshore Engineering	3	0	0	3
8.	U18PECE068	Structural engineering	Masonry Structures	3	0	0	3

PROFESSIONAL ELECTIVE –VII (PE –VII)

S.No	Course Code	Specialization	Subject Name	L	T	P	C
1	U18PECE071	Transportation Engineering	Airport Planning and Design	3	0	0	3
2	U18PECE072	Construction Engineering & Management	Contract Management	3	0	0	3
3	U18PECE073	Environmental Engineering	Environmental Laws and Policy	3	0	0	3
4	U18PECE074	Hydraulic Engineering	Hydraulic Modeling	3	0	0	3
5	U18PECE075	Hydrology & Water Resources Engineering	Water Resources Field Methods	3	0	0	3
6	U18PECE076	Structural engineering	Bridge Engineering	3	0	0	3
7	U18PECE077	Geotechnical Engineering	Structural Geology	3	0	0	3
8	U18PECE078	Environmental Engineering	Ecological Engineering	3	0	0	3

*** OPEN ELECTIVES FROM CIVIL ENGINEERING**

OPEN ELECTIVE								
Sl.No.	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18OECE001	OE	Metro Systems and Engineering	3	3	0	0	3
2	U18OECE002	OE	Pollution Regulations	3	3	0	0	3
3	U18OECE003	OE	Road Safety	3	3	0	0	3
4	U18OECE004	OE	Infrastructure Development	3	3	0	0	3
5	U18OECE005	OE	Project Safety Management	3	3	0	0	3
6	U18OECE006	OE	Environment, Health and Safety in Industries	3	3	0	0	3

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Course Code	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18HSMC111	HS	Communicative English	4	2	0	2	3
2	U18HSMC121	HS	Technical English	2	1	1	0	2
3	U18HSBA501	HS	Organisational Behavior	3	3	0	0	3
						Total Credits		**7**

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Course Code	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18ESC111	ES	Programming for Problem Solving Basic	3	3	0	0	3
2	U18ESC112	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18ESC121	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
4	U18ESCE301	ES	Computer Aided Civil Engineering Drawing	2	2	0	0	2
5	U18ESME301	ES	Engineering Mechanics	4	3	1	0	4
PRACTICAL								
4	U18ESC122L	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
5	U18ESC121L	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
6	U18ESCE3L1	ES	Computer Aided Civil Engineering Drawing	2	0	0	2	1

PROFESSIONAL CORE COURSES

Sl.No.	Course Code	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCCE301	PC	Engineering Geology	2	2	0	0	2
2	U18PCCE302	PC	Construction Technology	3	3	0	0	3
3	U18PCCE303	PC	Introduction to Civil Engineering	3	3	0	0	3
4	U18PCCE304	PC	Surveying and Geomatics	2	1	1	0	2
5	U18PCCE401	PC	Reinforced concrete Design	3	3	0	0	3
6	U18PCCE402	PC	Introduction to Fluid Mechanics	2	2	0	0	2
7	U18PCCE403	PC	Introduction to Solid Mechanics	2	2	0	0	2
8	U18PCCE404	PC	Building Materials & Testing Methods	2	1	1	0	2
9	U18PCCE405	PC	Geotechnical Engineering	2	2	0	0	2
10	U18PCCE501	PC	Structural Analysis I	3	3	0	0	3
11	U18PCCE502	PC	Hydraulic Engineering	2	2	0	0	2
12	U18PCCE503	PC	Foundation Engineering	3	3	0	0	3
13	U18PCCE504	PC	Hydrology and Water Resources Engineering	3	3	0	0	3
14	U18PCCE505	PC	Environmental Engineering	3	3	0	0	3
15	U18PCCE601	PC	Structural Analysis II	3	3	0	0	3
16	U18PCCE602	PC	Estimation & Costing	3	2	1	0	3
17	U18PCCE603	PC	Physico-Chemical Processes for Water and Wastewater Treatment	3	3	0	0	3
18	U18PCCE604	PC	Design of Steel Structures	3	3	0	0	3
19	U18PCCE701	PC	Disaster Preparedness & Planning Management	3	3	0	0	3
20	U18PCCE702	PC	Professional Practice, Law &Ethics	2	2	0	0	2
21	U18PCCE703	PC	Transportation Engineering	2	2	0	0	2

PRACTICALS								
22	U18ESCE3L1	ES	Computer Aided Civil Engineering Drawing	2	0	0	2	1
23	U18PCCE3L2	PC	Surveying and Geomatics	2	0	0	2	1
24	U18PCCE3L3	PC	Engineering Geology Laboratory	2	0	0	2	1
25	U18PCCE4L1	PC	Geotechnical Engineering Laboratory	2	0	0	2	1
26	U18PCCE4L2	PC	Fluid Mechanics Laboratory	2	0	0	2	1
27	U18PCCE4L3	PC	Building Materials & Testing Laboratory	2	0	0	2	1
28	U18PCCE5L1	PC	Hydraulic Engineering Laboratory	2	0	0	2	1
29	U18PCCE5L2	PC	Environmental Engineering Laboratory	2	0	0	2	1
30	U18PCCE6L1	PC	Estimation & Costing Laboratory	2	0	0	2	1

MANDATORY COURSES (MC)

Sl. No.	Course Code	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18MCTH121	MC	Environmental Sciences	4	2	0	2	0
2	U18MCTH401	MC	Constitution of India	2	2	0	0	0
3	U18MCTH501	MC	Universal Human Values	2	2	0	0	0
4	U18MCTH601	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
ACTIVITY BASED COURSES								
1	U18MCAB111	MC	Physical health – Sports & Games	2	0	0	2	0
2	U18MCAB112	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	U18MCAB122	MC	Yoga	2	0	0	2	0
4	U18MCAB123	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	MC	Culture – Intangible Cultural,	2	0	0	2	0

			heritage(festivals, Food ways, Local games)					
7	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
8	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
9	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
13	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
14	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
15	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total Contact Hours	**40**	**8**	**0**	**32**	**0**

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management Ccourses (HS)	3	3	-	-	3	-	-		9	5.33
2	Maths&Basic Sciences (BS)	10	15	3	4	-	-	-		32	18.93
3	Engineering Sciences (ES)	7.5	7.5	7	-	-	-	-		22	13.02
4	Professional Core (PC)	-	-	12	14	17	13	7		63	37.28
5	Core Electives (PE)	-	-	-	-	3	6	6	6	21	12.43
6	Open Electives (OE)	-	-	-	-	-	3	3		6	3.55
7	Massive Open Online Course(MOOC)	-	-	-	-	-	-	-	2	2	1.18
8	Employment Enhancement Courses (EEC)	-	-	-	-	-	-	5	9	14	8.28
9	Mandatory courses(MC)	-	-	-	-	-	-	-			
	Total Credit	20.5	25.5	22	18	23	22	21	17	169	100%
	Total Contact Hour	35	36	29	26	30	29	29	28	242	

SEMESTER I

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				

OBJECTIVES: To gain fundamental knowledge of language and the uses in daily life.

UNIT I SPEAKING **6**

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing oneself – exchanging personal information- narrating events, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING **6**

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -The concept of Word Formation

UNIT III LISTENING **6**

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING **6**

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT **6**

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations

4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES (COs)	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H										H		H	
	CO2		M							M			M	H	
	CO3			H							H			H	
	CO4				H		M						L	H	
	CO5					H		H	L					H	
3	Category	Humanities and Social Studies (HS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSMA101	Engineering Mathematics – I (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical)	L	T	P	C
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				

OBJECTIVES: The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10^{th} edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9^{th} edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2^{nd} edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions.Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H				M		L			L			H	
	CO2	H		H	L	M			M				M	H	
	CO3	H				M				L				H	
	CO4	H	M			M				L			L	H	
	CO5	H		H		M				M	L			H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

UNIT I NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT II ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT III THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations,

reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT IV WAVE OPTICS **9**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT V LASERS **9**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

COURSE OUTCOMES (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H	H	M	H	M			M	H	H			H	
	CO2	L	H	M	M	H			M		L	H	M	H	
	CO3	H	L			L			M	M		M		H	
	CO4	H	L			L			M	M		M	L	H	
	CO5	H	M	M	M				M		H	L		H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSCH101	ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				

OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES & STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by

Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H			M		H		H		L			H	
	CO2		L	H		M		H		M		L	M	H	
	CO3		M		H		L				M			H	
	CO4	H		M	L			M			H		L	H	
	CO5		L		L		M				H			H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				

OBJECTIVES: To gain fundamental knowledge of algorithmic problem solving and python programming.

MODULE 1 :ALGORITHIMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart,programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;variables, expressions, statements, tuple assignment, precedence of operators, comments; modulesand functions, function definition and use, flow of execution, parameters and arguments; Illustrativeprograms: exchange the values of two variables, circulate the values of n variables, distance betweentwo Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters;Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods;advanced list,Processing list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handlingexceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updatedfor Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H	H	H	M	H	M	L		M	L	M		H	
	CO2	H	H	M	M		M		L			M	M	H	
	CO3	M	M	L	H	M		L		L		M		H	
	CO4	M	M	L	M	H	M	L	M	L		M	L	H	
	CO5	M	H	L	M	M			M	M	L			H	
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES: To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP;

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4:SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planesperpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings,Symbols, Conventions and Abbreviations.Drawing of residential single and two storied buildingswith detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top viewand side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students willgetExposure to basics of building construction
CO4	Students willgetExposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H			M			H						H	
	CO2	H	H	L		H	M						M	H	
	CO3			H										H	
	CO4											H	L	H	
	CO5	H						L						H	
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSPH2L1	WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace, Auto & Nano Tech)	L	T	P	C
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart knowledge practical physics to the students

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

COURSE OUTCOMES (COs)	
CO1	Understand the fundamental concept of optics
CO2	Understand the concept of production of ultrasonic waves
CO3	Understand the basic concept of Mechanics

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H		H	H						H	L		H	
	CO2	H	H	L								L	M	H	
	CO3	H	H	L								M		H	
3	Category	Basic Sciences (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSCH2L4	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				

OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystalliza and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method

CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base andConductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

		Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H		M	M		H		H		L			H	
	CO2	L	H			M		H		M		L	M	H	
	CO3		M		M						M			H	
	CO4	H		M				M				H	L	H	
	CO5		H		L		M				H			H	
3	Category	Basic Sciences (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				

OBJECTIVES: To enhance the practical knowledge on writing programs using Python

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. ExSOnentiation (SOwer of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H	H	M	H	H	M	M	M	M		M		H	
	CO2	H	H	L	H	H	M	L	M	M	M	M	M	H	
	CO3	H	H	M	M	M	M		M	M	M	M		H	
	CO4	H	M	H	H	H	M	M	M	M	L		L	H	
	CO5	H	H	M	H	M	M		M	M	L	M		H	
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

SEMESTER II

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				

OBJECTIVES: To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage

Learning, USA: 2007

COURSE OUTCOMES (COs)	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	M										H		H	
	CO2		H							M			M	H	
	CO3			H							H			H	
	CO4				M		H						L	H	
	CO5					M		M	L					H	
3	Category	Humanities and Social Studies (HS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSMA201	Engineering Mathematics II (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical)	L	T	P	C
	Total Contact Periods - 60	4	0	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				

OBJECTIVE: The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	M		L		H				M		H		H	
	CO2	H	M			H			M		L			H	
	CO3	H		L				M		H				H	
	CO4								H	M	M	L		H	
	CO5	H		L	L			M				H		H	
3	Category	Basic Science (BS)													

4	Approval	Meeting of Academic Council, May 2018

U18BSPH201	**INTRODUCTION TO MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart basic knowledge of mechanics involving 1D, 2D and 3D motions ofa rigid body

UNIT 1 **9**

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2 **9**

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3 **9**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4 **9**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5 **9**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" DhanpatRai Publications" 2012.
2. M.K. Harbola, "Engineering Mechanics", 2nd edition, Cengage, 2013.
3. M.K. Verma, "Introduction to Mechanics", 1st edition, CRC press, 2009.
4. D.Kleppner&R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, "Engineering Mechanics – DynamicsVol 2", 7th ed. Wiley, 2012
6. JP Den Hartog, "Mechanical Vibrations", Dover Publications, Inc., 1985
7. WT Thomson, "Theory of Vibrations with Applications", Pearson, 5th edition, 1997.
8. Online References: Wikipedia org

COURSE OUTCOMES (COs)	
CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1			L	L					M				H	
	CO2	H		L	L	H				M		L		H	
	CO3	M				M				H				H	
	CO4	H		L	L					M		L		H	
	CO5	L		H	H	M				M		L		H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSCH201	ENVIRONMENTAL SCIENCE	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				

OBJECTIVES: To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL SOLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN SOPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.
Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems

CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

		Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H			M		H		H		L			H	
	CO2	L	H	H		M		H		M		L		H	
	CO3		M				L			H	M			H	
	CO4	H		M	L			M				M		H	
	CO5		H		L		M				H			H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation- nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications,

2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure
CO2	To understand about biodiversity and its conservation
CO3	To know the fundamentals of genetics and the immune system
CO4	To create an awareness about human diseases
CO5	To give a basic knowledge of the applications of transgenics

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H					M	M			H	M		H	
	CO2	H			M		H		M	M				H	
	CO3	M		M			M							H	
	CO4							H			M	M		H	
	CO5	H	H					H	M	M				H	
3	Category	Basic Science (BS)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To gain fundamental knowledge of Electrical and Electronics Engineering and its applications

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transformations Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real

power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS 9

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS 6

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology,Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H	L			M				H		L		H	
	CO2	H	L			M				H		L		H	
	CO3	H	M			M				H		L		H	
	CO4	H	L			M				H		L		H	
	CO5	H	L			M				H		L		H	
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESME1L2	**Workshop/Manufacturing Practices Lab (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES: To educate the students on common manufacturing processes employed in Industries.

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice
2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.
3. Carpentry **(9 hours)**
   a) Preparation Lap joints.
   b) Mortise and Tenonjoints.
   c) Cross Half.
   d) Dove Tail.
4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
   Preparation of butt joints, lap joints and tee joints
5. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

6. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1											H		H	
	CO2			H	M							H		H	
	CO3		M											H	
	CO4	H			L							H		H	
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws

2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	a	b	c	d	E	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	H	H			H				H		M		H	
	CO2	H	H			H				H		M		H	
	CO3	H	H			H				H		M		H	
	CO4	H	H			H				H		M		H	
	CO5	H	H			H				H		M			
3	Category	Engineering Sciences (ES)													
4	Approval	Meeting of Academic Council, May 2018													

SEMESTER III

U18BSMA306	**TRANSFOR AND PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	2	1	0	3
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by – Dept of Civil Engineering				
	➢ Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms. ➢ Learn techniques of solving the standard types of first order and second order partial differential equations. ➢ Learn solving wave and heat equation using Fourier series. Understand the problems using Fourier transform and their properties				

UNIT I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS **12**

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation.

UNIT IV FOURIER TRANSFORMS **9**

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
3. Venkataraman. M. K. "Engineering Mathematics Volume III" , 13th Edition National Publishing Company, Chennai, 1998.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12thEdition, Addison-Wesley, Pearson.
5. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
6. https://www.academia.edu/38267463/Higher_engineering_mathematics_bs_grewal
7. https://soaneemrana.org/onewebmedia/ADVANCED%20ENGINEERING%20MATHEM

ATICS%20BY%20ERWIN%20ERESZIG1.pdf
8. http://issc.uj.ac.za/appliedmaths/honours/pde/Haberman,%20R-Elementary%20Applied%20Partial%20Differential%20Equations%20With%20Fourier%20Series%20And%20Boundary%20Value%20Problems-Prentice%20Hall%20PTR%20(1987).pdf

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.
CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications.

U18ESCE301	**COMPUTER- AIDED CIVIL ENGINEERING DRAWING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**2**	**0**	**0**	**2**
	Prerequisite: Engineering graphics and design				
	Course Coordinator Name & Department: Ms.Thendral, Civil Engineering				

COURSE OBJECTIVES: Develop Parametric design and the conventions of formal engineering drawing. Produce and interpret 2D & 3D drawings. Communicate a design idea/concept graphically/ visually.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understand the benefits of computer aided design	U
CO2	Knowledge of symbols and sign conventions.	R
CO3	To Understand the arrangement bonds.	U
CO4	Students learn 2D modeling	Ap
CO5	Students learn modeling 3d Drawings	Ap
CO6	To learn the pictorial view of the buildings	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			1				3				1	3	3
	CO2	3									3			2	
	CO3		2			2				3				3	2
	CO4	3									2				2
	CO5							3					1	3	3
	CO6	1			1				2		3				2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	**Engg. Sciences (ES)**	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 6

Introduction to concept of drawings, Interpretation of typicaldrawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II SYMBOLS AND SIGN CONVENTIONS 6

Materials, Architectural, Structural,Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

UNIT III MASONRY BONDS 6

Masonry, Types of Masonry, Brickwork, Bond**,** English Bond and Flemish Bond – Corner wall and Crosswalls - One brick wall and one and half brick wall

UNIT IV BUILDING DRAWING 6

Terms, Elements of planning, building, drawing, Methodsof making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

UNIT V PICTORIAL VIEW 6

Principles of isometrics and perspective drawing. Perspectiveview of building. Fundamentals of Building Information Modeling (BIM)

TEXT BOOKS:

1. Verma B.P ,"Civil Engg. Drawing & House planning", Khanna publishers, Delhi, 2014
2. Building Design and Drawing by A. D. Pawar, V. S. Limaye and V. G. Shetti,2015
3. Shah M.G. Kalec. M. & Patki SY Building Drawing, Tata Mcgraw Hill, New Delhi, 2000

REFERENCES:

1. M. G. Shah, C. M. Kale, S. Y. Patki ,"Building drawing", Tata McGraw-Hill, 2002
2. Kumaraswamy N, Kameswara Rao A,"Building Planning & Drawing", Charotar Publishing House, 2013
3. https://openlibrary.org/works/OL16752086W/A_handbook_for_mapping_engineering_and_architectural_drawing
4. https://openlibrary.org/works/OL1892570W/Architectural_drafting_and_design
5. https://openlibrary.org/works/OL5646378W/Building_construction_and_drawing

Course Coordinator HOD

U18ESME301	ENGINEERING MECHANICS	L	T	P	C
	Total Contact Hours: 30	3	1	0	4
	Prerequisite: Wave Optics and Mechanics				
	Course Coordinator Name & Department: Mr.S.Vinothkumar, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Use scalar and vector analytical techniques for analysing forces in statically determinate structures	An
CO2	Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems, Apply basic knowledge of math and physics to solve real-world problem	Ap
CO3	Apply basic knowledge of math and physics to solve real-world problems	Ap
CO4	Understand basic dynamics concepts – force, momentum, work and energy	U
CO5	Understand and be able to apply Newton's laws of motion	U
CO6	To learn about beams and its types	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3									2				2
	CO2							3					1	3	3
	CO3	1			1				2		3				2
	CO4	3	3		3				2				3		
	CO5					3			3		2			3	
	CO6	3							3	2			1		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	**Engg. Sciences (ES)**	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION TO ENGINEERING MECHANICS 12

Force Systems Basic concepts,Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

UNIT II FRICTION, BASIC STRUCTURAL ANALYSIS, 12

Types of friction, Limiting friction, Laws of Friction, Staticand Dynamic Friction; Motion

of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method ofSections; Method of Joints; determinination of member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines; Area moment of inertia.

UNIT III VIRTUAL WORK AND ENERGY METHOD 12

Virtual displacements, Centroid and Centre of Gravity covering principle of virtualwork for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. Rectilinear motion.

UNIT IV INTRODUCTION TO KINETICS OF RIGID BODIES 12

Basic terms, general principlesin dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

UNIT V MECHANICAL VIBRATIONS 12

Basic terminology, free and forced vibrations,resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.

TEXT BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. Hibbeler R. C. (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press.

REFERENCE

1. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
2. Hibbeler R.C. and Gupta. A (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
3. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
4. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
5. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
6. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
7. https://openlibrary.org/works/OL1698695W/Engineering_mechanics
8. https://openlibrary.org/works/OL1440581W/Vector_mechanics_for_engineers
9. https://openlibrary.org/works/OL15244490W/Engineering_mechanics

Course Coordinator **HOD**

	ENGINEERING GEOLOGY	L	T	P	C
U18PCCE301	Total Contact Hours: 45	**2**	**0**	**0**	**2**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department: Dr.Venkata Krishnaiah, Civil Engineering				
COURSE OBJECTIVES: The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study					

examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials.		
COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice	An
CO2	Rock mass characterization and the mechanics of planar rock slides and topples.	C
CO3	Evaluate rock-mass quality and perform a kinematic analysis.	C
CO4	To Apply the method of slices and factor of safety equation to solve rotational slide problem.	Ap
CO5	The mechanics of soils and fluids and their influence on settlement, liquefaction, and soil slope stability.	C
CO6	To learn about different seismic zones in India	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	3		3				2				3		
	CO2					3			3		2			3	
	CO3	3							3	2			1		3
	CO4	3	2											3	3
	CO5							1			3				
	CO6	3			3					3			1	3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 GENERAL GEOLOGY 9

Introduction-Branches of geology useful to civil engineering, scope of geologicalstudies in various civil engineering projects,Weathering. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM.Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD.

UNIT II PETROLOGY 9

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

UNIT III STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS 9

Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to

civil engineering. Geophysical methods – Seismic and electrical methods for subsurface investigations

UNIT IV GEOLOGICAL HAZARDS 9

Rock Instability and Slope movement: Concept of slidingblocks. Different controlling factors. Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth.

UNIT V GEOLOGICAL INVESTIGATION 9

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings.Coastal protection structures. Investigation of Landslides and earthquakes - causes and mitigation , seismic zonation – seismic zones of India.

TEXT BOOKS

1. Engineering and General Geology, Parbin Singh, Published by *S.K. Kataria & Sons*, (2014).
2. Engineering Geology for Civil Engineers, Varghese P.C, PHI Learning Pvt. Ltd., (2011)

REFERENCES

1. Text Book of Engineering Geology, N. Chenna kesavulu, 2nd Edition Macmillan Publishers India. (2009),
2. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).
3. Engineering Geology, Subinoy Gangopadhyay, Publisher: Oxford University (2013).
4. http://www.sasurieengg.com/e-course-material/CIVIL/II Year%20Sem%203/CE6301%20Engineering%20Geology.pdf
5. https://www.goodreads.com/book/show/4874812-engineering-geology?ac=1&from_search=true
6. https://www.goodreads.com/book/show/17986288-engineering-geology?ac=1&from_search=true

Course Coordinator **HOD**

U18PCCE302	**CONSTRUCTION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Ms.K.Anitha, Civil Engineering				

COURSE OBJECTIVES: To make the student to become more familiar with the advanced construction methods and practice involved in heavy construction like box jacking, pipe jacking, basement tunneling techniques of off-shore platforms.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about the Specifications, details and sequence of activities in construction	E
CO2	To know about the Fabrication and erection of pre cast building components.	E
CO3	To learn the Sub Structure Construction Techniques	Ap
CO4	To understand the concepts involved in Super Structure Construction Techniques	U
CO5	To study the construction practices in industrial structure, braced domes and space decks.	An

CO6	To learn about prestressing in high rise structures.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2							2		3	1	3	3
	CO2							1			3				
	CO3	3	2		3					3			1	3	2
	CO4	2										3		3	3
	CO5		2							2					
	CO6	2							2		3	3	3	3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms.

UNIT II FABRICATION AND ERECTION 9

Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection;

UNIT III CONSTRUCTION TECHNIQUES 9

Sub Structure Construction- Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation;

UNIT IV SUPER STRUCTURE CONSTRUCTION 9

Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures,

UNIT V CONSTRUCTION EQUIPMENTS 9

Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks;

TEXT BOOKS:

1. S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai & Sons,

New Delhi, 2010.
2. S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press, New Delhi, 2008.
3. B.C. Punamia, Building Construction, Laxmi Publications, New Delhi, Eleventh Edition, 2016.
4. S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand,Thirty Third Edition, 2017.

REFERENCES:

1. R. Chudley, Construction Technology Vol. I, II, III, IV, Longman Group Limited,London, Twenty Third Edition, 2005.
2. R. Chudley (revised by R. Greeno), Building Construction Handbook, Addison Wesley, Longman Group, England, 3rd ed., 1999.
3. S.S. Ataev, Mir Publishers, Moscow, 1999.
4. https://openlibrary.org/works/OL5647089W/Building_construction
5. https://openlibrary.org/works/OL17354199W/Building_construction
6. https://openlibrary.org/works/OL3479737W/Construction

Course Coordinator **HOD**

U18PCCE303	**INTRODUCTION TO CIVIL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Introduction to mechanics				
	Course Coordinator Name & Department: Ms.P.Mugilvani, Civil Engineering				

COURSE OBJECTIVES: To impart basic knowledge on Civil. To familiarize the materials used in Civil Engineering structures. To provide the exposure on the fundamental elements of civil engineering fields.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understanding monumental buildings	U
CO2	To study buiding materials and construction management and to uderstand repairs & rehabilitation of structures.	E
CO3	To familiarize various fields of civil engineering including environmental impact.	An
CO4	Understand the basics in specialized fields of civil engineering.	U
CO5	Introduction to advanced analytical methods and general purpose FEM program.	C
CO6	To get knowledge on softwares used in Civil Engineering	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2				2	3					3		3	3
	CO2		2							2					
	CO3	2					3		2		3	3	3	3	2
	CO4	3			2	3								1	
	CO5	3	3	3				2		2	2			1	2
	CO6				2		3					2		1	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: BASICS OF CIVIL ENGINEERING & HISTORY OF ARCHITECTURE 9

Broad disciples of Civil Engineering / Infrastructure, Scopes for career. Construction and development over time. Material developments, Construction methods Eminent works. Construction industries, 5-year plan outlay, Budgets for Infrastructures. Aesthetics in Civil Engineering - Fundamentals of architectural design, town planning; Building System (HVAC, LEED) ratings – Smart Cities.

UNIT II: BUILDING MATERIALS AND CONSTRUCTION MANAGEMENT 9

Stones, bricks, mortars, Plain- Reinforced and prestressed Concrete. Chemicals in Construction. Structural Steels, High tensile Steel, Carbon Composites, Plastics, Recycling and disposal of Demolition wastes. Temporary structures in Construction, Costruction methods for various structure, Contrction Equipments, Management System; Importance of Costruction Management. Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and otherstructural distress mechanisms; simple systems of rehabilitation of structures.

UNIT III CIVIL ENGINEERING - I 9

Environmental Engineering & Sustainability: Water, Effluenttreatment treatment systems; Solid waste management;

Geotechnical Engineering:, rock mechanics and geology;various types of foundations; basics of rock mechanics & tunnelling

Hydraulics, Hydrology &Water Resources Engineering: Fundamentals of fluid flow,basics of water supply systems; Underground Structures; Underground Structures

Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems;Ports & Harbours and other marine structures

Surveying & Geomatics: Basic surveying techniques, Total Stations,
GPS, LIDAR;

UNIT IV CIVIL ENGINEERING - II 9

Traffic & Transportation Engineering: Development and challenges in integrated transport development in India: road, rail, air. Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic;

Power Plant Structures: Chimneys, Natural & Induced Draught Cooling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects

Structural Engineering: Types of buildings; tall structures; various types of bridges;
Water retaining structures; Other structural systems;
Wind tunnel studies;

UNIT V COMPUTATIONAL METHODS IN CIVIL ENGINEERING 9

Computational Methods, IT in Civil Engineering: Typical software used in CivilEngineering-Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA,

AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …). Industrial lectures: Case studies of large civil engineering projects by industryprofessionals, covering comprehensive planning to commissioning;

TEXT BOOKS

1. The National Building Code, BIS, (2017)
2. RERA Act, (2017)
3. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
4. Chandiramani, Neelima (2000), the Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
5. Avtarsingh (2002), Law of Contract, Eastern Book Co.

REFERENCE:

1. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
2. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.
3. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
4. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency
5. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
   Bare text (2005), Right to Information Act.
6. https://openlibrary.org/works/OL18169263W/Introduction_to_autocad_2008_for_civil_engineering_applications
7. https://www.goodreads.com/book/show/14827751-civil-engineering
8. https://civilenglineering.files.wordpress.com/2014/10/the-civil-engineering-handbook.pdf

Course Coordinator **HOD**

U18PCCE304	SURVEYING AND GEOMATICS	L	T	P	C
	Total Contact Hours: 45	1	1	0	2
	Prerequisite: Engineering Graphics & design				
	Course Coordinator Name & Department: Ms. Maria Subhashini, Civil Engineering				

COURSE OBJECTIVES: To develop mid level professionals in *Surveying*/*Geomatics* with adequate knowledge and skills also in social and human sciences that is necessary to deal with issues related to land-man relation such as Land Reform and Management, Hydropower, Irrigation, Road, Building Construction, Aviation, Land Resource Planning

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Carry out preliminary surveying in the field of civil engineering applications	An
CO2	Set out curves, buildings, culverts and tunnels.	C
CO3	Have knowledge to modern methods of surveying like Total station, Hydrographic survey and cartography	An
CO4	Have knowledge to modern methods of surveying like Photogrammetry	An
CO5	Apply the concepts of Electro Magnetic energy, spectrum and spectral signature curves in the practical problems	Ap
CO6	To learn about sensors and digital image processing.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			2	3		2		3		3		1	
	CO2	3	3	3				2		2	2		1	1	2
	CO3	2			2		3					2		1	3
	CO4									2					
	CO5	3		3		3			3		2			3	3
	CO6	3	1			3		3		3		3	1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION TO SURVEYING 9

Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.Triangulation and Trilateration.

UNIT II THEODOLITE SURVEY AND CURVE 9

Theodolite survey: Instruments, Measurement ofhorizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single correctionsElements of simple and compound curves – Method of settingout– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

UNIT III MODERN FIELD SURVEY SYSTEMS 9

Principle of Electronic DistanceMeasurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

UNIT IV PHOTOGRAMMETRYSURVEYING 9

Introduction, Basic concepts, perspectivegeometry of aerial photograph, relief and tilt displacements, terrestrial photo grammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.

UNIT V REMOTESENSING 9

Introduction –Electromagnetic Spectrum, interactionof electromagnetic radiation with the

atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

TEXT BOOKS:

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.

REFERENCE:

1. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
2. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
3. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.
4. https://www.goodreads.com/book/show/1664828.Elementary_Surveying?from_search=true
5. https://openlibrary.org/works/OL1864858W/Surveying
6. https://openlibrary.org/works/OL241021W/Surveying

Course Coordinator **HOD**

U18ESCE3L1	**COMPUTER-AIDED CIVIL ENGINEERING DRAWING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Engineering Graphics & design				
	Course Coordinator Name & Department: Ms. R.Chitra, Civil Engineering				

COURSE OBJECTIVES: To introduce the students to draw the plan, elevation and sectional views of buildings in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Carry out preliminary surveying in the field of civil engineering applications	M
CO2	Set out curves, buildings, culverts and tunnels	M
CO3	Have knowledge to modern methods of surveying like Total station, Hydrographic survey and cartography	COR
CO4	Have knowledge to modern methods of surveying like Photogrammetry	M
CO5	Apply the concepts of Electro Magnetic energy, spectrum and spectral signature curves in the practical problems	A
CO6	To learn about remote height using total station.	P

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1						3			2				2	2
	CO2	3		3		3			3		2			3	3
	CO3	3	1		2	3		3		3		3	1	3	3

	CO4		2			2			2		2				
	CO5	2					3		3	2				1	1
	CO6		2		1						3	2	1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	**Engg. Sciences (ES)**	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF DRAWING EXPERIMENTS:

1. Buildings with load bearing walls including details of doors and windows.
2. Standard drawings of a typical two storeyed building including all.
3. Electrical Circuit drawing for Single storeyed building
4. Plumbing connection drawing for single storeyed building.
5. RCC framed structures
6. Reinforcement drawings for typical slabs,
7. Reinforcement drawings for beams and columns
8. Reinforcement drawing for spread footings
9. Industrial buildings - North light roof structures – Trusses
10. Perspective view of one and two storey buildings

TEXT BOOKS:

1. Verma B.P ,"Civil Engg. Drawing & House planning", Khanna publishers, Delhi, 2014
2. Building Design and Drawing by A. D. Pawar, V. S. Limaye and V. G. Shetti,2015
3. Shah M.G. Kalec. M. & Patki SY Building Drawing, Tata Mcgraw Hill, New Delhi, 2000

REFERENCES:

1. M. G. Shah, C. M. Kale, S. Y. Patki ,"Building drawing", Tata McGraw-Hill, 2002
2. Kumaraswamy N, Kameswara Rao A,"Building Planning & Drawing", Charotar Publishing House, 2013

Course Coordinator **HOD**

U18ESCE3L2	**SURVEYING AND GEOMATICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Engineering Graphics & design				
	Course Coordinator Name & Department: Ms.Marisubhashini, Civil Engineering				

COURSE OBJECTIVES: To understand and posses the knowledge about field techniques in Surveying. To understand field problems like tachometry, setting out for foundation marking etc. The student is also exposed to the Modern Surveying methods.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about drawing of Residential Building using Autocad	O
CO2	To study about drawing of symbols and sign	O
CO3	To study about drawing of RCC framed using Autocad	O
CO4	To study about drawing of various types of RCC structures	O

CO5	To study about drawing of various types of Truss	COR
CO6	To learn about Traversing and Contouring using total station.	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2			2			2		2		3	3	
	CO2	2					3		3	2				1	1
	CO3		2		1						3	2	1		3
	CO4	3				3		2	3					2	2
	CO5			2				2		2	3		1		
	CO6	3		2		3		2	1		3			1	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	**Engg. Sciences (ES)**	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIMENTS

1. a) Simple chain survey - problems involving instruments such as optical and prism Square - cross staff.
   b) Overcoming obstacles in chaining and ranging.
2. a) Measurement of bearing of survey lines by prismatic compass.
   b) Running closed and open compass traverse.
   c) Plotting and Adjustments of traverse.
3. a) Plane table survey of building or a park or a road by different methods. ‘
   b) Field solution of two and three point problems.
   c) Problems in leveling.
4. Traversing using total station.
5. Contouring using total station.
6. Determination of remote height using total station.
7. Stake out using total station. Distance, gradient ,diff, height between two inaccessible points using total station.

TEXT BOOKS:

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011

REFERENCE

1. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
2. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
3. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Course Coordinator **HOD**

U18ESCE3L3	**ENGINEERING GEOLOGY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department: Mr.Vinothkumar, Civil Engineering				

COURSE OBJECTIVES: Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice	A
CO2	Rock mass characterization and the mechanics of planar rock slides and topples.	M
CO3	Evaluate rock-mass quality and perform a kinematic analysis.	A
CO4	To Apply the method of slices and factor of safety equation to solve rotational slide problems.	COR
CO5	The mechanics of soils and fluids and their influence on settlement, liquefaction, and soil slope stability.	P
CO6	To learn the Use of clinometers compass and Burton compass	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3		2	3					2	2
	CO2			2				2		2	3		1		
	CO3	3		2		3		2	1		3			1	2
	CO4	2					3		3	2				1	1
	CO5		2		1						3	2	1		3
	CO6	3				3		2	3					2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	**Engg. Sciences (ES)**	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPRIEMENTS:

1. Study of Physical properties of minerals
2. Identification of rocks forming silicate and ore minerals
3. Recognition of rocks
4. Use of clinometers compass and Burton compass for measurement dip and strike of formations.

5. Geological cross sections and study of geological maps.
6. Study of models of geological structures and out crops patterns of different types of rocks and land forms

REFERENCES

1.Engineering and General Geology, Parbin Singh, 8th Edition , S K Kataria & Sons Publishers (2010)
2. Text Book of Engineering Geology, N. Chenna kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

Course Coordinator **HOD**

U18MCAB305	**CULTURE-LEARNING AN ART FORM**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Ms.Mugivani.P, Civil Engineering				

COURSE OBJECTIVES: To know the concept of Culture, Civilization and Heritage. To know more in the subject of general characteristics of culture and importance of culture in human life.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about concept of culture	O & A
CO2	To study about culture and civilization	O & A
CO3	To study about culture and heritage	O & A
CO4	To study about characteristics of culture	O & A
CO5	To study about importance of culture in human life	O & P
CO6	To learn the diversity and ideational in culture	O & P

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1			2				2		2	3		1	3	3
	CO2	3		2		3		2	1		3			1	2
	CO3	2					3		3	2				2	1
	CO4		2		1						3	2	1		3
	CO5	3				3		2	3					2	2
	CO6			2				2		2	3		1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**

4	Approval	Meeting of Academic Council, May 2018

UNIT I: CONCEPT OF CULTURE 6

Culture, food you eat, the clothes you wear, the language you speak in aspects of culture, Art, music, literature, architecture, sculpture, philosophy, religion and science in aspects of culture.

UNIT II: CULTURE AND CIVILIZATION 6

Culture and civilization, Culture different from civilization, Humans: physical, mental and spiritual, social and political civilization.

UNIT III: CULTURE AND HERITAGE 6

Cultural development is a historical process, ancestors, cultural heritage, human heritage, architectural creations, monuments, material artifacts, the intellectual achievements, philosophy, and treasures of knowledge, scientific inventions and discoveries

UNIT IV: GENERAL CHARACTERISTICS OF CULTURE 6

Culture is learned and acquired, Culture is shared by a group of people, Culture is cumulative, Culture changes, Culture is dynamic, Culture gives us a range of permissible behavior patterns, Culture is diverse, and Culture is ideational.

UNIT V: IMPORTANCE OF CULTURE IN HUMAN LIFE 6

Culture and life, traditions, beliefs, way of life, fundamental element of culture, religious belief and its symbolic expression, three eternal and universal values of Truth, Beauty and Goodness are closely linked with culture, philosophy and religion.

TEXT BOOKS:

1. Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): The Trading World of the Indian Ocean, 1500-1800 (History of Science, Philosophy and Culture 361 in Indian Civilization, ed. by D.P. Chattopadhyaya, vol. III, 7), Pearson, Delhi, 2012, pp. 53- 116.
2. Chaudhuri, Kirti N.: Trade and Civilisation in the Indian Ocean, CUP, Cambridge, 1985.
3. Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus
4. Books, Delhi, 2010. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian.

REFERENCE:

1. Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV
2. Christie, J.W., 1999, The Banigrama in the Indian Ocean and the Java sea during the earlyAsian trade boom, Communarute‘s maritimes de l‘ocean indien, Brepols

Course Coordinator **HOD**

U18MCAB306	**CULTURE-LEARNING AN ART FORM**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Ms.Saritha, Civil Engineering				
COURSE OBJECTIVES: Describe the distinctive features of Indian culture; Identify the central points and uniqueness of Indian culture; Discuss the importance of spirituality in Indian culture; Explain the points of diversity and underlying unity in it; and Trace the process of infusion into and integration of elements from other cultures in Indian culture. The importance of festivals, food and sports of India.					

COURSE OUTCOMES (COs):		Revised Bloom's Taxonomy
CO1	To study about concept of culture	A & GR
CO2	To study about culture and civilization	A & GR
CO3	To study about culture and heritage	A & GR
CO4	To study about characteristics of culture	A & GR
CO5	To study about importance of culture in human life	A & GR
CO6	To learn the social and cultural values in sports	A & GR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2					3		3	2				2	1
	CO2		2		1						3	2	1		3
	CO3	3				3		2	3					2	2
	CO4	3	2			3		2	3					2	2
	CO5		3	2				2		2	3		1		
	CO6	3		2		3		2	1		3			1	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: CHARACTERISTICS OF INDIAN CULTURE 6

Indian culture, physical and social environment, continuity and change, variety and unity, secular outlook, universalism, materialistic and spiritualistic.

UNIT II: CULTURAL IDENTITY, RELIGION, REGION AND ETHNICITY 6

Religion and region, cultural influences, Cultural synthesis, spirituality, Adaptability as a characteristic of Indian culture, unity in diversity.

UNIT III: FESTIVALS, HOLIDAYS, CELEBRATIONS 6

Diwali, Holi, Rakhi, Lohri, Eid, Christmas, Indian Independence DayIndian Republic Day and Gandhi Jayanti.

UNIT IV: FOOD 6

Indian foods,traditional foods,traditional food practices,food preparation, Indian food systems, food-ways, food habits, food ingredients land of spices, Mughlai food, regional foods, beverages, types of beverages

UNIT V: TRADITIONAL SPORTS OF INDIA 6

Traditional sports in India, Festival sports, social and cultural values in sports, Chaupar/

Pachisi, Kabaddi, Kho-Kho Mallakhamb, Gilli-Danda, Jallikattu, Kalaripayattu

TEXT/ BOOKS:

1. Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): The Trading World of the Indian Ocean, 1500-1800 (History of Science, Philosophy and Culture 361 in Indian Civilization, ed. by D.P. Chattopadhyaya, vol. III, 7), Pearson, Delhi, 2012, pp. 53- 116.
2. Chaudhuri, Kirti N.: Trade and Civilisation in the Indian Ocean, CUP, Cambridge, 1985.
3. Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus
4. Books, Delhi, 2010. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian.

REFERENCE:

1. Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV
2. Christie, J.W., 1999, The Banigrama in the Indian Ocean and the Java sea during the early
3. Asian trade boom, Communarute‘s maritimes de l‘ocean indien, Brepols

Course Coordinator **HOD**

SEMESTER IV

U18BSMA402	PROBABILITY, STATISTICS AND NUMERICAL METHODS	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Basic knowledge in probability and statistics and Engineering Mathematics I & II				
	Course Designed by – Dept of Mathematics				
OBJECTIVES	➢ The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. ➢ It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT 1 PROBABILITY DISTRIBUTION (9+3)Hrs

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT II STATISTICS AND TESTING OF HYPOTHESIS (9+3)Hrs

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

UNIT III SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS (9+3)Hrs

Fixed Point Iteration methods - Newton-Raphson method and Regula-Falsi method for single variable-solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT IV FINITE DIFFERENCE AND INTERPOLATION (9+3)Hrs

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT V NUMERICAL DIFFERNTIATION AND INTEGRATION (9+3)Hrs

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

TEXT BOOKS

1. Sastry. S. S "Introductory Numerical Methods" PHI, 2010.
2. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005.
3. S.C.Gupta&V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003.

REFERENCEBOOKS

1. Grewal, B.S. "Higher Engineering Mathematics (42nd edition)" Khanna Publication Delhi, 2016.
2. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company, 2nd Edition 2010.
3. Veerarajan T. "Probability Statistics and Random Process" Tata McGraw Hill, New Delhi 2003.

COURSE OUTCOMES (COs)	
CO1	Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.
CO2	Learn the basic idea of statistics including measures of central tendency Identify the appropriate hypothesis testing procedure based on type of outcome variable and number of samples
CO3	Gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO4	Interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO5	Understand the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2
CO1	H	M		L	H	M	L	M	M	L	M	H		
CO2	H		H	L	M	L	L	M		M	S	M	H	
CO3	H				M	L			L		M	M		L
CO4	H	M			M		M		L		M	M`		H
CO5	H		H		M	M		M	M	L	M	H	H	M
Category	BASIC SCIENCE (BS)													
Approval	48th Meeting of the Academic Council													

U18PCCE401	**REINFORCED CONCRETE DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Engineering Mechanics				
	Course Coordinator Name & Department: Ms.R.Chitra, Civil Engineering				

COURSE OBJECTIVES: To study the strength behavior and design of reinforced concrete members subjected to moment shear and axial forces including the properties of concrete material behavior.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Design RC concrete structural elements using various methods.	C
CO2	Design reinforced concrete slabs and beams by WSD for flexure	C
CO3	Design various basic elements of reinforced concrete structures like slabs, beams, columns and footings by LSD	C
CO4	Design reinforced concrete slabs and beams for shear and torsion by LSD	C
CO5	Design reinforced concrete Footing	C
CO6	To learn the design philosophy in concrete behavior	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-

Medium, 1-Low															
1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2					3		3	2				2	3
	CO2		2		1						3	2	1		3
	CO3	3				3		2	3					2	2
	CO4		2		1						3	2	1		3
	CO5	3				3		2	3					2	2
	CO6			2				2		2	3		1		
3	Category	Humanities & Social Sciences including Management Courses (HS)		Basic Sciences (BS)		Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)		Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)		Mandatory Courses (MC)	
4	Approval	Meeting of Academic Council, May 2018													

UNIT I INTRODUCTION 9

Concrete - Properties of ingredients, properties of fresh concrete, defects in concrete and influence of other factors - study and strength behavior of concrete – Introduction to working stress method – design of singly and doubly reinforced beams.

UNIT II WORKING STRESS METHOD 9

Design of continuous beams and slabs – axially and eccentrically loaded column footings for individual columns and combined rectangular footings for two columns.

UNIT III LIMIT STATE DESIGN OF BEAMS 9

Introduction to Limit state method - Limit state design of rectangular T and L shaped beams for flexure, shear, bond torsion, - design of one way slab, two way slab – Lintels – sun shades.

UNIT IV DESIGN OF COLUMNS 9

Limit state design of short rectangular and circular columns for axial and eccentric loads using SP- 16 design of long columns.

UNIT V DESIGN OF FOOTING 9

Limit state design of square / rectangular footings for axially and eccentrically loaded columns combined rectangular footings for two columns.

TEXT BOOKS:

1. Krishnaraju, N. ‘Reinforced Concrete Design’, CBS Publishers and Distributors, Delhi. 2016.
2. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, Pvt. Ltd., New Delhi. 2002.
3. Gambhir.M.L., “Fundamentals of Reinforced Concrete Design”, Prentice Hall of India Private Limited, New Delhi. 2006.
4. Subramanian,N., ”Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi. 2013.

REFERENCES:

1. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2009.
3. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publication Pvt. Ltd., New Delhi, 2007.
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118635360
5. https://bitsathy.ac.in/civil/syllabus/pg/2015.pdf
6. http://www.sasurieengg.com/e-course material/CIVIL/IIIyear%20Sem%205/CE6505%20Design%20of%20Reinforced%20Concrete%20Elements.pdf

Course Coordinator **HOD**

U18PCCE402	**INTRODUCTION TO FLUID MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**2**	**0**	**0**	**2**
	Prerequisite: Introduction to Mechanics				
	Course Coordinator Name & Department: Mr.Rajesh, Civil Engineering				

COURSE OBJECTIVES: The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications A training to analyze engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To learn about the basics of fluid mechanics and various properties of fluids	Ap
CO2	Understand the broad principles of fluid statics	U
CO3	To have a clear understanding about fluid kinematics	U
CO4	Understand the broad principles of fluid dynamics	U
CO5	To apply the continuity, momentum and energy principles	Ap
CO6	To learn the basic concepts of design flow	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2					3		3	2				2	
	CO2		2		1						3	2	1		3
	CO3	3				3		2	3					2	2
	CO4		2		1						3	2	1		
	CO5	3				3		2	3					2	2
	CO6		2		1						3	2	1		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BASICS OF FLUID MECHANICS 6

Basic Concepts and Definitions – Distinction between a fluid and a solid;Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

UNIT II FLUID STATICS 6

Fluid Pressure: Pressure at a point, Pascals law, pressure variationwith temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces.Buoyancy and stability of floating bodies.

UNIT III BASIC CONCEPTS OF FLUID FLOW 6

Classification of fluid flow : steady and unsteady flow; uniformand non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

UNIT IV DYNAMICS 6

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation;Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube.

UNIT V MOMENTUM PRICIPLES OF FLUDIS 6

Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

TEXT BOOKS

1.A Textbook of Fluid Mechanics by R K Bansal, Laxmi Publication (2010)

2. Textbook of Hydraulics and Fluid Mechanics by R.S. Khurmi, S. Chand Publishing (2015)

3. Fluid Mechanics, Hydraulics and Hydraulic Machines, KR Arora, Standard Publishers Distributors (2005)

REFERENCES

1.Fluid Mechanics and Machinery, C.S.P.Ojha, .Berndtsson and P. N. Chadramouli, Oxford University Press, (2010)

2.Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House Publishers (2015).

3. https://books.google.co.in/books?id=6PJ6CgAAQBAJ&pg=PA695&lpg=PA695&dq=Fluid+Mechanics,+Hydraulics+and+Hydraulic+Machines,+KR+Arora,
4. https://www.scribd.com/document/337067093/R-K-Bansal-A-Textbook-of-Fluid-Mechanics-and-Hydraulic-Machines-9th-Revised-Edition-SI-Units-Chp-1-11-Laxmi-Publications-2010-pdf

Course Coordinator **HOD**

U18PCCE403	**INTRODUCTION TO SOLID MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**2**	**0**	**0**	**2**
	Prerequisite: Introduction to Mechanics				
	Course Coordinator Name & Department: Ms. Anitha, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to introduce to continuum mechanics and material modeling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To apply the fundamental concepts of stress and strain in the design of various structural components and machines	Ap
CO2	To determine the bending, shear stresses and deflection produced in a beam subjected to system of loads	E
CO3	To study about the Shear stress distribution across varioussections	U
CO4	To determine deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections	E
CO5	To solve torsion problems in bars and thin walled members	An
CO6	To get knowledge in bending and shear stresses	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2		1						3	2	1		3
	CO2	3				3		2	3					2	2
	CO3		2		1						3	2	1		2
	CO4	3						2	2					3	
	CO5		2		1						3				3
	CO6	3						2				2		2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I CONCEPTS OF SIMPLE STRESSES AND STRAINS 6

Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law –

Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses – Thin Cylinders and Shells – Strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load – Compound Bars.

UNIT II BENDING MOMENT AND SHEAR FORCE 6

Beams and Bending- Types of loads, supports, Bending moment and Shear Force diagrams for cantilevers, simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads and uniformly distributed loads, uniformly varying loads, application of moments.

UNIT III STRESSES AND SIMPLE BENDING 6

Derivation of bending equation - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula –Shear stress distribution across variousbeam sections like rectangular, circular, triangular, I, T angle sections.

UNIT IV SLOPE DEFLECTION AND TORSION 6

Relationship between moment, slope and deflection,Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams. Torsion- Derivation of torsion equation and its assumptions. Applications of theequations. Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

UNIT V THIN CYLINDERS AND SPHERES 6

Thin Cylinders and Spheres- Derivation of formulae and calculations of hoopstress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

TEXT BOOKS

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, (2007).
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, (2010).
3. Strength of Materials, RK Bansal, Laxmi Publications (2010)

REFERENCES

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, (2009).
2. Timoshenko.S.B. and Gere.J.M, "Mechanics of Materials", Van Nos Reinbhold, New Delhi (1995).
3. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi,(1995).
4.https://www.svce.ac.in/departments/cve/downloads/Mechanics%20of%20Solids/Unit%20I%20-%20PPT.pdf
5.https://www.lecturenotes.in/notes/20733-note-for-engineering-mechanics-em-by-engineering-kings/6

Course Coordinator HOD

U18PCCE404	BUILDING MATERIALS & TESTING METHODS	L	T	P	C
	Total Contact Hours: 30	1	1	0	2
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Ms.Arunya.A, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the materials used in engineering	U
CO2	To envisage the properties of materials used in engineering	R
CO3	To know about the testing of various materials	R
CO4	To evaluate the behavioral properties of engineering materials	E
CO5	To know the testing procedures for Civil engineering materials	R
CO6	To get knowledge in fracture mechanics for different materials	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3		2	3					2	2
	CO2		2		1					2	3	2	1		2
	CO3	3						2	2					3	
	CO4	2		3		2							2		3
	CO5		2					2		2	2				
	CO6	2			2		1		1			2		2	1

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION TO ENGINEERING MATERIALS 6

Introduction to Engineering Materials –Manufacturing of bricks, Cements, M-Sand, Various types of concrete , Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes.

UNIT II MATERIAL PROPERTIES 6

Introduction to Material,Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals. Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on)

UNIT III BEHAVIOUR OF MATERIALS 6

True stress - Strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; concept of fatigue materials; Introduction to brittle material behaviors.

UNIT IV EVALUATION OF MATERIALS 6

Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; IS code; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture Mechanics – background;Hardness testing on different materials.

UNIT V MATERIAL TESTING 6

Testing of bricks, Fine aggregate, coarse aggregate, concrete. Testing of special materials - Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties.

TEXT BOOKS

1. Non-Destructive Test and Evaluation of Materials, Second Edition,J Prasad, C. G. Krishnadas NairPublisher: McGraw-Hill Education (2011)
2.Chudley, R., Greeno,'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann Publisher (2006)

REFERENCES

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition (2013)
2. Highway Engineering, Engineering, Kadiyali, Khanna Book Publishing Co. (P) Ltd., Delhi (2017).
3.http://site.iugaza.edu.ps/mymousa/files/Material_-Testing-lab-manual.pdf
4.https://www.tcu-via.com/attachments/article/236/construction-handbook-chudley.pdf

Course Coordinator **HOD**

U18PCCE405	GEOTECHNICAL ENGINEERING	L	T	P	C
	Total Contact Hours: 30	2	0	0	2
	Prerequisite: Engineering Geology				
	Course Coordinator Name & Department: Mr.P.Dayakar, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to explain what Geotechnical Engineering is and how it is important to civil engineering, to explain how three phase system is used in soil and how are soil properties estimated using three phase system, to explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated, to determine shear parameters and stress changes in soil due to foundation loads and to estimate the magnitude and time-rate of settlement due to consolidation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Carry out soil identification, index properties and soil classification	U
CO2	Solving any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.	An
CO3	Understand the principles of compaction and solve practical problems related to consolidation settlement	Ap

CO4	Identify shear strength parameters for field conditions	E
CO5	Understand the basic concept of analysis of slope stability	An
CO6	Understand the methods of site exploration and preparation of soil investigation report	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2		3		2							2	3	3
	CO2		2					2		2	2				
	CO3	2			2		1		1			2		2	1
	CO4		2		1					2	3	2	1		2
	CO5	3						2	2					3	
	CO6	2		3		2							2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 6

Types of soils and their formation and deposition, Scope of soil engineering. Soil as three-phase system, Basic Definitions and phase relationships-, Determination of Index Properties, Plasticity Characteristics of Soil - consistency limits- Classification of Soils-Introduction of soil classification: particle size classification, Indian standard soil classification system.

UNIT II SOIL WATER AND WATER FLOW 6

Soil water - Capillary rise in soils, Permeability of Soil - Darcy's law, Determination of coefficient of permeability: Laboratory and Field methods: Permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- characteristics of flow nets, Effective stress Concept in Soils, quick sand condition, Stress distribution in soil media –Boussinesq Formula- Use of influence charts

UNIT III COMPACTION AND CONSOLIDATION OF SOIL 6

Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density, Field compaction control, comparison between compaction and consolidation, Components of settlement - Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory.

UNIT IV SHEAR STRENGTH OF SOIL 6

Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behavior of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. Unconfined compression test, vane shear test.

UNIT V SLOPE STABILITY AND SOIL EXPLORATION 6

Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, Swedish circle method, Friction circle method, stability numbers and charts. Methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, borehole logs, geophysical methods.

TEXT BOOKS:

1. Punmia P.C., "Soil Mechanics and Foundations ", Laxmi Publications Pvt. Ltd., New Delhi 2017
2. Principles of Geotechnical Engineering, Braja Das, Cengage 8Th Edition, 2014
3. Basic and applied Soil Mechanics, Rajan & Rao, New Age International Publishers,2007
4. Soil Mechanics & Foundation Engineering, KR Arora, Standard Publishers,7Th Edition,2014

REFERENCES:

1. Soil Mechanics by Craig R.F., Chapman & Hall,7Th Edition,2014
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
4. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy.
5. https://books.google.co.in/books?id=lUZOCgAAQBAJ&pg=PA234&lpg=PA234&dq=4.%09Soil+Mechanics+%26+Foundation+Engineering,+KR+Arora,+Standard+Publishers,7Th+Edition,2014
6. https://aunotes.in/t/ce8491-soil-mechanics-notes/513

Course Coordinator **HOD**

U18MCTH401	CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours: 30	2	0	0	0
	Prerequisite: +2 Level				
	Course Coordinator Name & Department: Ms.Mariasubhashini, Civil Engineering				

COURSE OBJECTIVES: To educate the students on the basic concepts of Indian Constitution and various organs created by the constitution including their functions.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	To Understand the functions of the Indian government.	U
CO2	To Understand and abide the rules of the Indian constitution.	R
CO3	To Understand central and state government functionalities in India.	U
CO4	To Understand Constitutional Amendments.	R
CO5	To Understand the Indian Society.	U
CO6	To Understand the Constitutional functionaries and assesments of the Indian government.	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2		1					2	3	2	1		2
	CO2	3						2	2					3	
	CO3	2		3		2							2		3
	CO4	3									2	2		3	
	CO5	2		3		2			2				2	3	3
	CO6		2					2		2	2		1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 6

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 6

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 6

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS 6

Indian Federal System – Center – State Relations – President‟s Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V INDIAN SOCIETY 6

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TEXT BOOKS:

1. Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi,2015.
2. The Constitution of India, PM Bhakshi, Universal Law,2013.
3. R.C.Agarwal, “Indian Political System”, S.Chand and Company, New Delhi.
4. Maciver and Page, “ Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, NewDelhi,2011.
2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd,2015.
4. http://mls.org.in/books/Salient%20Features%20of%20the%20Constitution%20of%20India.pdf

Course Coordinator **HOD**

U18PCCE4L1	**GEOTECHNICAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Engineering Geology Laboratory				
	Course Coordinator Name & Department: Dr.R.VenkataKrishnaiah, Civil Engineering				

COURSE OBJECTIVES: The objective of this course is to explain how are soil properties estimated using three phase system, to explain role of water in soil behaviour and permeability and to estimate the quantity of seepage, to determine shear parameters and to estimate the magnitude and time-rate of settlement due to consolidation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understand different types of soil according to index properties and their classification.	P
CO2	Carryout soil properties according to Atterberg's limits.	G
CO3	Understand the relationship between optimum moisture content and maximum dry density of Soil.	P
CO4	Study about permeability characteristics of soil.	M
CO5	Understand the concept of consolidation theory	M
CO6	Evaluating the shear strength properties of soilunder different drainage conditions.	P

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3						2	2					3	
	CO2	2		3		2							2		3
	CO3	3									2	2		3	
	CO4		2		1					2	3	2	1		2
	CO5	2		3		2							2		3
	CO6	3									2	2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIEMENTS

1. Field Density using Core cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven drying method.
4. Field identification of Fine grained soils.
5. Specific gravity of soils.
6. Grain size distribution by Sieve analysis.
7. Grain size distribution by Hydrometer analysis.
8. Consistency limits by Liquid limit test.
9. Consistency limits by Plastic limit test.
10. Consistency limits by Shrinkage limit test.
11. Permeability test using Constant-head method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation test.
17. Triaxial shear test (UU)
18. Vane shear test
19. Direct shear test
20. Unconfined Compression Strength test.

REFERENCES:

1. Lambe T.W., “Soil Testing for Engineers ", John Wiley and Sons, New York, 1990.
2. "I. S. Code of Practice (2720) Relevant Parts ", as amended from time to time.
3. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Co-operative Society, Chennai.
4. https://www.gopalancolleges.com/gcem/course-material/civil/lab-manuals/sem-VI/10CVL67_Geotechnical-Engineering_LAB.PDF
5. https://www.iare.ac.in/sites/default/files/lab1/IARE_GTE_Lab_Manual.pdf

Course Coordinator **HOD**

U18PCCE4L2	**FLUID MECHANICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Mr.Vinoth, Civil Engineering				
COURSE OBJECTIVES: The ability to understand the concepts of liquid flow will be the main objective of learning this subject.					
COURSE OUTCOMES (COs):					**Revised Bloom’s Taxonomy**

CO1	To learn about the basics of fluid mechanics and various properties of fluids	O
CO2	Understand the broad principles of fluid statics	M
CO3	To have a clear understanding about fluid kinematics	M
CO4	Understand the broad principles of fluid dynamics	O
CO5	To apply the continuity, momentum and energy principles	M
CO6	To learn about the applications of different pumps.	M & COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2		1					2	3	2	1		2
	CO2	2		3		2							2		3
	CO3	3									2	2		3	
	CO4	2		3		2							2		3
	CO5	3									2	2		3	
	CO6	2		3		2			2				2	3	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIMENTS :

A. Flow Measurement

1. Calibration of Venturimeter / Orificemeter
2. Bernoulli's Experiment

B. Losses in Pipes

3. Determination of friction factor in pipes
4. Determination of minor losses

C. Pumps

5. Characteristics of Centrifugal pumps
6. Characteristics of Gear pump
7. Characteristics of Submersible pump
8. Characteristics of Reciprocating pump

D. Turbines

9. Characteristics of Pelton wheel turbine
10. Characteristics of Francis turbine/Kaplan turbine

REFERENCES:

1. Sarbjit Singh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited, Delhi,(2009).
2. "Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, (2004).
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, (2000).
4. Subramanya K. "Flow in open channels", Tata McGraw Hill Publishing.Company, (2001).

5. https://www.vidyarthiplus.com/vp/Thread-CE6461-Fluid-Mechanics-and-Machinery-Laboratory-Manual-RVS-Edition#.XcESEtIzYdU
6. https://www.technicalsymposium.com/newmech_labprograms.html

Course Coordinator **HOD**

U18PCCE4L3	**BUILDING MATERIALS & TESTING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Ms.Arunya.A, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the materials used in engineering	O
CO2	To envisage the properties of materials used in engineering	M
CO3	To know about the testing of various materials	M
CO4	To evaluate the behavioral properties of engineering materials	M
CO5	To know the testing procedures for Civil engineering materials	M
CO6	To learn about the preliminary test on materials.	M

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3									2	2		3	
	CO2	2		3		2							2		3
	CO3	3									2	2		3	
	CO4	2		3		2							2		3
	CO5	3									2	2		3	
	CO6		2		1					2	3	2	1		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIMENTS

1. Compression test on wood
2. Torsion test on mild steel rod
3. Impact test on metal specimen (Izod and Charpy)
4. Hardness test on metals (Rockwell and Brinell Hardness Tests)

TEST ON AGGREGATES

a. Specific Gravity
b. Water Absorption of Aggregates
TEST ON BITUMEN
a) Specific Gravity of Bitumen
b) Penetration Test
c) Viscosity Test
d) Softening Point Test
e) Ductility Test
TEST ON BITUMINOUS MIXES
a) Determination of Binder Content
b) Marshall Stability and Flow Values

REFERENCES

1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2. "Soil Engineering Laboratory Instruction Manual" published by Engineering College Cooperative Society, Anna University, Chennai, 2010.
3. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
4. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.
5. http://standardtestinglab.com/building-material.html
6. http://site.iugaza.edu.ps/mymousa/files/Material_-Testing-lab-manual.pdf

Course Coordinator **HOD**

U18MCAB407	**LITERATURE & MEDIA – LITERATURE, CINEMA & MEDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: +2 Level Language				
	Course Coordinator Name & Department: Mr,Anish.C, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to deal with importance of literature in tele media & mass media. The main goal is to make the students aware about the interpretation of data & literature in the field of cinema & media.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the mass media	O & S
CO2	To evaluate the theories of audience	GR
CO3	To study about the Approaches to media analysis	GR
CO4	To study about the Cultural Studies approach	O & A
CO5	To know about the media culture	O
CO6	To learn about the people culture Versus popular culture.	O & S

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3				3		2	2		3	
	CO2		2		1					2	3	2	1	2	2

	CO3	2		3		2							2		3
	CO4	3					3		2	2	3			3	
	CO5	2		3		2							2		3
	CO6	3			2		3		3		2	2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION TO MASS MEDIA 6

Understanding mass media. Characteristics of mass media. Effects of mass media on individual, society and culture-basic issues. Power of mass media. Media in Indian society. Definition, nature and scope. Function of mass media.

UNIT II AUDIENCE ANALYSIS 6

Media Audience analysis (mass, segmentation, product etc, social uses). Audience making. Active Vs Passive audience: Some theories of audience-Uses and Gratification, Uses and Effects.

UNIT III MEDIAANALYSIS 6

Media as text. Approaches to media analysis Marxist, Semiotics, Sociology, Psychoanalysis. Media and realism-class, gender, race, age, minorities, children .

UNIT IV MULTI FACE APPROACH OF MASS MEDIA 6

Media as consciousness Industry. Social construction of reality by media. Rhetoric of the image, narrative etc. Media myths (representation, stereotypes etc.) - Cultural Studies approach to media, audience as textual determinant, audience as readers, audience positioning, establishing critical autonomy.

UNIT V SOCIOLOGY AND MEDIA 6

Media and Popular culture-commodities, culture and sub-culture, popular texts, popular discrimination, politics popular culture, popular culture Vs people's culture, celebrity industry-personality as brand name, hero-worship etc. Acquisition and transformation of popular culture

TEXT BOOKS

1. Potter, James W, Media Literacy.Sage Publications (1998)
2.Grossberg, Lawrence , Media-Making: Mass Media in a popular culture. Sage Publications (1998)

REFERENCES

1.Berger, Asa Authur , Media Analysis Technique.Sage Publications (1998).
2. http://ac-journal.org/journal/vol3/Iss1/reviews/kandath.htm
3.https://pdfs.semanticscholar.org/6485/198762836f7d8073242a6617f4523ab57670.pdf

Course Coordinator HOD

U18MCAB408	**LITERATURE & MEDIA – GROUP READING OF CLASSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: +2 Level Language				
	Course Coordinator Name & Department: Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to make the students to acquire wide knowledge regarding the classic works, which in turn shall develop their knowledge they envisage in literature and general media.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the Cultural Studies approach	O & S
CO2	To know about the communication patterns	GR
CO3	To study about the Writing commercials	GR
CO4	To study about the Information society	O & A
CO5	To know about the Principles of publication design	O
CO6	To learn about the writing of script for radio, TV and online content,.	O & S

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2		3		2							2		3
	CO2	3					3		2	2	3			3	
	CO3	2		3		2							2		3
	CO4	3			3				3		2	2		3	
	CO5		2		1					2	3	2	1	2	2
	CO6	2		3		2							2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I ORGANIZATIONAL BEHAVIOR 6

Behavior in media Organization and Organizational Behavior. Nature and Structure of different Media Organizations-AIR/DD, Private Satellite Channels, Production Houses, employment opportunities in Indian Media industry, Group Behavior, Innovation and Creativity, Culture of organization.

UNIT II INTERPERSONAL COMMUNICATION IN MEDIA 6

Theories and Models-Transactional analysis.Ideation and Creative Thinking-Lateral Thinking. Group communication: Theories and Models-Decision making process, leadership, team work communication patterns group context.

UNIT III MEDIA WORKSHOP 6

Workshop style classes: Write commercials and news script for broadcast use.Five different script writing assignments. Submit a record of news stories written by you for a newspaper, a feature for a magazine, a script for a radio Programme, a script for a TV programme and an online content for an e-zine, e-newspaper or blog.

UNIT IV MEDIA INFORMATION SYSTEM 6

Information society – concepts and theories of information society – information super highway – knowledge society and knowledge gap theory – Technological determinism and Global village.

UNIT V ARTICULATION AND PUBLICATION 6

Elements and Principles of publication design. Page-makeup & Layout. Types of Layout-Books, Magazines, Brochures, Catalogues etc. Typography, copy fitting, communication through typography. Special designs .

TEXT BOOKS

1. Teach Yourself Photoshop, Jennifer Alspach & Linda Richards, IDG Books, New Delhi, (2000).
2. Multimedia: An Introduction by John Villamil & Louis Moloina Prentice Hall, New Delhi, (1998).

REFERENCES

1. Multimedia – Making it work, Tay Vaughan, Mc Graw Hill, NewYork, (1998).
2. The Ultimate Multimedia Handbook, J. Keyes, Mc Graw Hill, NewYork, (2000).
3.http://ac-journal.org/journal/vol3/Iss1/reviews/kandath.htm
4.https://pdfs.semanticscholar.org/6485/198762836f7d8073242a6617f4523ab57670.pdf

Course Coordinator HOD

SEMESTER V

U18PCCE501	STRUCTURAL ANALYSIS – I	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Introduction to Solid Mechanics				
	Course Coordinator Name & Department: Ms.Thendral.S, Civil Engineering				

COURSE OBJECTIVES: To introduce the students about the advanced theory and concepts of structural analysis and the classical methods for the analysis of structures and also gives an introduction to finite element methods.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Introduction to Energy Principles	R
CO2	To learn the principles of virtual work method.	An
CO3	To Understand analysis of indeterminate flexibility matrix method.	U &An
CO4	To analyse the continuous beam using stiffness matrix method.	An
CO5	Introduction to the finite element method for plane stress and plane strain	A
CO6	To learn the analysis of determinate and indeterminate structures.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3					3		2	2	3			3	
	CO2	2	3	3		2		2					2		3
	CO3	3			3				3		2	2		3	
	CO4		2					3							2
	CO5	2		3		2							2		3
	CO6	3	1				3		2	2	3			3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I ENERGY PRINCIPLES 9

Introduction to static and Kinematic Indeterminacy - Conservative and non-conservative systems – Strain energy and complimentary energy – Beam in bending – Shear and torsion - Castigliano's first theorem, Engesser's theorem, castigliano's second theorem, Maxwell's theorem.

UNIT II PRINCIPLE OF VIRTUAL WORK METHOD 9

2 D State of Stress – 2 D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle – Plane trusses: Analysis of plane trusses – method of joints –

method of sections – virtual work method

UNIT III FLEXIBILITY METHOD 9

Introduction to Slope Deflection Method - Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames.

UNIT IV STIFFNESS METHOD 9

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames.

UNIT V FINITE ELEMENT METHOD 9

Introduction to the finite element method for plane stress and plane strain - numerical analysis of plane trusses, grids and frames - Introduction – Discretisation of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain - Triangular elements.

TEXT BOOKS:

1. Structural Analysis – Vol I & Vol II- Dr.R.Vaidhayanathan & Dr.P.Perumal, Laxmi Publications, New Delhi, 2003.
2. Analysis of Structures-Vol I & Vol II by V.N. Vazirani & M.M.Ratwani, Khanna Publications, New Delhi, 2015.
3. Analysis of Structures by T.S. Thandavamoorthy, Oxford University Press, New Delhi,2011.
4. Structural Analysis by S S Bhavikatti ,Vikas Publishing House,2013.

REFERENCES:

1. M.L.Gambir, ”Fundamentals of mechanics and analysis” PHI Learning Pvt.Ltd.,2011.
2. R.S.Khurmi, ”Theory of Structures”,S.Chand Publishing, 2013.
3. Russell C.Hibbeler, Tankiang Hwee,” Structural Analysis”, Prentice Hall,2012.
4. https://nptel.ac.in/courses/105105166/#
5. https://lecturenotes.in/notes/5683-notes-for-structural-analysis-1-sa-1-by-sushant-kumar
6. https://drive.google.com/file/d/1r4mPLen9qaRf1CLug6lFTKrxmRdSMvVp/view

Course Coordinator **HOD**

U18PCCE502	**HYDRAULIC ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Fluid Mechanics				
	Course Coordinator Name & Department: Mr.Rajesh, Civil Engineering				

COURSE OBJECTIVES: To introduce the students about the advanced theory and concepts of structural analysis and the classical methods for the analysis of structures and also gives an introduction to finite element methods.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Be able to apply their knowledge of fluid mechanics in addressing problems in Pipes.	Ap

CO2	To apply their knowledge of fluid mechanics in addressing problems in Laminar and Turbulent Flow.	Ap
CO3	They will have knowledge in Open Channel Flow.	U
CO4	They will have knowledge in measurement of Discharge and Velocity	U
CO5	They will have knowledge in Dimensional Analysis.	U
CO6	To know the concept of boundary layer theory.	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2					3						2	2
	CO2	2		3		2							2		3
	CO3	3	1				3		2	2	3			3	
	CO4	2									2				2
	CO5	2	3	3		2		2					2		3
	CO6	3			3				3		2	2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I FLOW THROUGH PIPES 6

Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks.

UNIT II LAMINAR FLOW AND TURBULENT FLOW 6

Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Turbulent Flow- Reynolds experiment,. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Moody's diagram.

UNIT III OPEN CHANNEL FLOW 6

Introduction- Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section, Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel.

UNIT IV VARIED FLOW 6

Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity Venturi Flume, Standing Wave Flume, Parshall Flume, Gradually

Varied Flow-Dynamic Equation of Gradually Varied Flow, Hydraulic Jump – Type of Jump, Location of Jumps – Energy losses in Jumps – Surges in Canal – Types of Surges.

UNIT V PUMPS AND TURBINES 6

Rotodynamic Machinery Pumps: Classification of pumps –Centrifugal Pumps – Casing – Impellor – Work done and Efficiency . Reciprocating pump – Work done – Air Vessel – Indicator Diagram

Rotodynamics Machinary Turbines: Classification of turbines -Work done - Efficiency of Turbines, Pelton Wheel, Francis turbine, Kaplan and propeller turbines. Similarity laws and specific speed. Performance of turbines.

TEXT BOOKS:

1. Bansal R K., A Text Book of Fluid Mechanics & Hydraulic Machines – Laxmi Publications 2017
2. Rajput R.K, A Text of Fluid Mechanics & Hydraulic machines – S.Chand & Co.P.Ltd 2015
3. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.

REFERENCES:

1. Subramanya K., "Flow in Open channels ", Tata McGraw Hill Publishing Company 2008
2. Kumar K.L., "Engineering Fluid Mechanics ", Eurasia Publishing House (P) Ltd. New Delhi, 2008.
3. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
4. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers.
5. https://drive.google.com/file/d/1SvzbHC-Umdf6glpjhoOBW32hJo6oRpyU/view
6. https://drive.google.com/file/d/1oGEFW8EqCqnuamZnLWe9Q85FKWctevbH/view

Course Coordinator **HOD**

U18PCCE503	**FOUNDATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**3**	**0**	**0**	**3**
	Prerequisite: Geotechnical Engineering				
	Course Coordinator Name & Department: Mr.P.Dayakar, Civil Engineering				

COURSE OBJECTIVES: To impart knowledge on common method of sub soil investigation and design of foundation and to acquire the capacity to investigate the soil condition and to select and design a suitable foundation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Select type of foundation required for the given soil condition.	R
CO2	Design the type of foundation for different types of soil	C
CO3	To determine the dimensions and settlements of pile foundations	E
CO4	Carryout earth pressure and stability analysis of retaining walls	An
CO5	To check the stability of slopes	U
CO6	To learn the concepts of Coloumb's wedge theory and Graphical method .	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2									2				2
	CO2	2	3	3		2		2					2		3
	CO3	3			3				3		2	2		3	
	CO4	3	1				3		2	2	3			3	
	CO5	2									2				2
	CO6	2	3	3		2		2					2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BEARING CAPACITY 9

Introduction – Location and depth of foundation – codal provisions – bearing capacity of shallow foundation on homogeneous deposits – bearing capacity from in-situ tests – Factors influencing bearing capacity – codal provisions – Settlement – Components of settlement – Settlement of foundations on granular and clay deposits – Allowable and maximum differential settlements of buildings – Codal provision – Methods of minimizing settlement.

UNIT II DESIGN OF FOOTING 9

Types of foundation – structural design of spread footing – Design aspects of combined and mat foundation – Codal provisions.

UNIT III PILE FOUNDATION 9

Types of piles – Factors influencing the selection of pile – Carrying capacity in granular and cohesive soils – Static and dynamic formulae – Capacity from in-situ tests– Piles subjected to uplift – Negative skin friction – Group capacity – Settlement of pile groups – Interpretation of pile load test – Pile caps – Codal provisions

UNIT IV RETAINING WALLS 9

Earth pressure theory – Plastic equilibrium in soils – active and passive states – Rankine's theory – Coloumb's wedge theory – Classical and limit equilibrium solution – Earth pressure on retaining walls of simple configurations – pressure on the wall due to single line load alone – Graphical method (Culmann's method alone) – Stability of retaining wall.

UNIT V SLOPE AND UNDERGROUND STRUCTURES 9

Slope failure mechanisms - Types - Infinite slopes - Finite slopes - Total stress analysis for saturated clay - Method of slices - friction circle method - Use of stability number - Slope protection measures.

TEXT BOOKS

1. Punmia, B.C., Soil mechanics and foundations, Laxmi publications pvt. Ltd., New Delhi.

REFERENCES

1. A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999.
2. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.
3. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.
4. Khan, I.H., A text book of Geotechnical Engineering, Prentice Hall of India, New Delhi, 1999.
5. Arora K.R. Soil mechanics and foundation engineering, standard publishers and distributors, New Delhi, 1997.
6. Bowles J.E. Foundation analysis and design, McGraw Hill, 1994.
7. Gopal Ranjan and Rao, A.S.R. Basic and applied soil mechanics, Wiley Eastern Ltd., New Delhi (India), 1997.
8. https://openlibrary.org/works/OL18095451W/The_Engineering_Foundation
9. https://openlibrary.org/works/OL17004244W/Report_geotechnical_engineering_recommendations

Course Coordinator **HOD**

U18PCCE504	**HYDROLOGY AND WATER RESOURCES ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Introduction toFluid Mechanics				
	Course Coordinator Name & Department: Ms.B.Saritha, Civil Engineering				

COURSE OBJECTIVES: To impart knowledge on hydrological cycle, spatial and temporal measurement and analysis of rainfall and their applications including flood routing and ground water hydrology..

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Measure the rainfall intensity, duration and frequency	U
CO2	To Assess the losses of precipitation due to evaporation	E
CO3	To Prepare the unit hydrograph for surface runoff	Ap
CO4	To Design the canal Systems.	C
CO5	To Prepare the Design considerations for Dams and Spillways.	Ap
CO6	To learn the concepts of SCS-CN method of estimating.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3				3		2	2		3	
	CO2	3			3				3		2	2		3	
	CO3	2	3	3		2		2					2		3
	CO4	3			3				3		2	2		3	
	CO5	2	3	3		2		2					2		3
	CO6	3			3				3		2	2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I HYDROMETEOROLOGY 9

Hydrological cycle -Hydro meteorological factors -water-budget equation, history of hydrology, sources of data-types of precipitation- Forms for precipitation- Density and Adequacy of rain gauges – Recording and non-recording gauges, mean precipitation over an area, depth area- duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

UNIT II PRECIPITATION AND ABSTRACTIONS 9

Spatial distribution – Consistency analysis – Frequency analysis – Intensity, duration, frequency relationships- Evaporation, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices

UNIT III GROUND WATER AND WELL HYDROLOGY 9

Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows. Forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells.

UNIT IV DISTRIBUTION SYSTEMS 9

Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

UNIT V DAMS AND SPILLWAYS 9

Embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

TEXT BOOKS:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill,2013.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill,2014.

REFERENCES:

1. G L Asawa, Irrigation Engineering, Wiley Eastern,2011.
2. L W Mays, Water Resources Engineering, Wiley,2010.
3. J D Zimmerman, Irrigation, John Wiley & Sons
4. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford,2008.
5. https://archive.org/stream/hydrologyfundame00mead?ref=ol#page/n8/mode/2up
6. https://openlibrary.org/account/login?redirect=/books/OL4717807M/Water-resources_engineering/borrow?action=join-waitinglist

Course Coordinator **HOD**

U18PCCE505	**ENVIRONMENTAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department:Dr.A.Mani, Civil Engineering				

COURSE OBJECTIVES: To make the students conversant with principles of water supply, treatment and distribution

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Plan water supply system for developing area	Ap
CO2	Design the various treatment plant in water supply system	C
CO3	Treat the drinking water using advanced techniques	U
CO4	Design the water distribution systems	C
CO5	Principles of design of water supply and drainage in buildings	C
CO6	To study the recycling and reuse concepts.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	3	3		2		2					2		3
	CO2	3			3				3		2	2		3	
	CO3	3	1	2			3		2	2	3			3	2
	CO4	2									2				2
	CO5	2	3	3		2		2					2	2	3
	CO6										2				

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT-I PLANNING FOR WATER SUPPLY AND SEWERAGE SYSTEMS 9

Public water supply System and Sewerage system – Design Period – Prediction of population during design period –

Selection of Sources of Water supply – Conveyance of Raw Water - Treatment site – Piped Flow – Open Channel Flow – Layout of Water Treatment Plant.

UNIT-II WATER TREATMENT SYSTEMS 9

Raw water Quality – Impurities in Water – Water Quality Standards – Plain Sedimentation - Pumping to Chemical House – Coagulation – Hydraulic Jump / Flash Mixer - Clariflocculator – Rapid Sand Filtration – Iron & Manganese Removal - Post Chlorination – Clear Water Tank – Pumping to Overhead Tank.

UNIT-III WATER DISTRIBUTION SYSTEM 9

Water Distribution Layout – Service Reservoirs – Hydraulics of Flow in Pipes – Appurtenances – Construction Operation and maintenance – Leak Detection – Strom Water Network – Plumbing Work in Houses.

UNIT-IV COLLECTION AND CONVEYANCE OF DOMESTIC SEWAGE 9

Sewer Pipe Network – Sewage Treatment Site – Activated Sludge Process – Aeration Tank Design – Design of Secondary Settling Tank – Sludge Digester – Sludge Drying Beds – Re-Use of Treated Effluent – Selection of Pumps.

UNIT-V SOLID WASTE MANAGEMENT 9

Collection and Conveyance of Solid Wastes – Segregation of Solid Wastes – Sanitary Land Fill Incineration – Recycling and Re-use Concepts – Disposal of Electronic Wastes.

TEXT BOOKS:

1. Garg S.K.Environmental Engineering, Vol.I & II, Khanna Publishers, New Delhi, (1994).
2. Water Supply Engineeering, R.Pannirselvam, SPGS-Publications, Adambakkam, Chennai- 600088, (2007).
3. Wastewater Engineering, SPGS-Publications, Adambakkam, Chennai-600088,(2007).
4. C.S.Shah, Water Supply Sanitation, Galgotia Publishing Company, New Delhi, (1994).

REFERENCES:

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, (1999).
2. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, (1993).
3. Wastewater Engineering – Treatment and Re-Use, MetCalf & Eddy, Inc., Tata McGraw-Hill Publishing Company, New Delhi-(2003).

Course Coordinator **HOD**

	ORGANIZATIONAL BEHAVIOR	**L**	**T**	**P**	**C**
U18HSBA501	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Mr.C.Anish, Civil Engineering				

COURSE OBJECTIVES:

1. Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups

4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour	Ap
CO2	Knowledge of the Interpersonal perception	Ap
CO3	Awareness of the Merits and Demerits of Group decision making.	R
CO4	Understanding of the Sources of power	U
CO5	Familiarity with the knowledge of types of Conflicts	Ap
CO6	To learn the Power and Authority.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3				2		3		3	3
	CO2		2	3				2							
	CO3	3									2		2		2
	CO4	3	1	2			3		2	2	3	2		3	2
	CO5	2				2					2				2
	CO6	3	1	2			3		2	2	3	3	3	3	2

3	Category	**Humanities & Social Sciences including Management Courses (HS)**	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I **9**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan
6. https://openlibrary.org/account/login?redirect=/books/OL43353M/Organizational_behavior/borrow?action=borrow
7. https://openlibrary.org/account/login?redirect=/books/OL22745591M/Organizational_behavior/borrow?action=join-waitinglist

Course Coordinator **HOD**

U18MCTH502	**UNIVERSAL HUMAN VALUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**2**	**0**	**0**	**0**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: The objective of the course is four fold:Sensitization of student towards self, family (relationship), society and nature.Understanding (or developing clarity) of nature, society and larger systems, on the basis of Human relationships and resolved individuals. Strengthening of self- reflection.Development of commitment and courage to act.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Students are expected to become more aware of their surroundings, society, social problems	An
CO2	Keep human relationships and human nature in mind	R
CO3	They would also become sensitive to their commitment towards what they believe in.	Ap
CO4	It is hoped that they would be able to apply what they have learnt	Ap
CO5	A beginning would be made in the direction to handle social problems and sustainable solutions	An
CO6	T o understand holistic perception of harmony at all levels of existence	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	1	2			3		2	2	3	2		3	2
	CO2	2				2					2				2
	CO3		2	3				2					2	3	
	CO4	3	3			1					2		2		2
	CO5	3	1	2			3		2	2	3	2		3	2
	CO6	2			2				2			2		3	1

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I COURSE INTRODUCTION **6**

Understanding the need, basic guidelines, content and process for Value Education. Self Exploration–- its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II: UNDERSTANDING HARMONY **6**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', needs of Self ('I') and 'Body' - Sukh and Suvidha-the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Swasthya.

UNIT III: HARMONY IN THE FAMILY AND SOCIETY **6**

Values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the meaning of Vishwas; Difference between intention and competence - the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.

UNIT IV HARMONY IN THE NATURE AND EXISTENCE **6**

Understanding the harmony in the nature - interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. existence as co-existence (*sah-astitva*) of mutually interacting units in all-pervasive space. holistic perception of harmony at all levels of existence

UNIT V HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 6

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems.

Course Coordinator **HOD**

U18PCCE5L1	HYDRAULIC ENGINEERING LABORATORY	L	T	P	C
	Total Contact Hours: 30	0	0	2	1
	Prerequisite: Fluid Mechanics Laboratory				
	Course Coordinator Name & Department: Mr.Rajesh, Civil Engineering				

COURSE OBJECTIVES: Students should be able to verify the principles studied in theory by performing the experiments in lab.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To measure theoretical discharge in pipes, Venturimeter, orificemeter and notches	M
CO2	To measure discharge in Uniform Flow and Gradually Varied Flow.	M
CO3	To measure Discharge and Energy loses in Hydraulic Jump.	M
CO4	To find minor and major losses in pipe	M
CO5	To measure venture flume and standing wave flume	M
CO6	To understand the turbulent and lamiar flow in pipes.	M

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	3			2			2		2			3	2
	CO2		2	3				2					2	3	
	CO3	3								3		2			3
	CO4			3					3		1			2	
	CO5	3	3			1					2		2		2
	CO6	3		2			3		2	2	3	2		3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIMENTS

1. Flow Visualization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow

10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
14. Laminar flow through pipes
15. Major losses / Minor losses in pipe

REFERENCES:

1. Dr.Modi P.N & Sethi S.M "Hydraulics and Hydraulic Mechanics". Standard, Publishing Co, New Delhi.
2. https://www.vidyarthiplus.com/vp/attachment.php?aid=48491
3. https://ia800309.us.archive.org/16/items/cihm_60249/cihm_60249.pdf

Course Coordinator **HOD**

U18PCCE5L2	**ENVIRONMENTAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Chemistry Laboratory				
	Course Coordinator Name & Department: Ms.B.Saritha, Civil Engineering				

COURSE OBJECTIVES: To understand sampling and preservation methods and significance and characterization of waste water.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Have a fundamental knowledge to conduct various quality tests on water and waste water	O
CO2	To Have a well-founded knowledge to assess the suitability of water for drinking and irrigation purpose.	GR
CO3	To Acquire skills in assessing the suitability of water for concreting works	P
CO4	To know the parameter levels of COD, BOD.	A
CO5	To calculate the Ambient noise measurement and air quality modelling	COR
CO6	To check the level of Chlorine in bleaching powder	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2			2			3		2			3
	CO2	3		3		3			3		1		3	2	
	CO3		3							3		2			2
	CO4	3			3			3		2		2		3	
	CO5		3				2				2				2
	CO6	2					1				2			2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF EXPERIMENTS

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Determination of Alkalinity
4. Determination of Total Hardness
5. Estimation of Chlorides
6. Estimation of Sulphate
7. Optimum coagulant dose
8. Dissolved Oxygen (D.O)
9. Biochemical Oxygen Demand (BOD)
10. Chemical Oxygen Demand (COD)
11. Residual Chlorine
12. Available Chlorine in bleaching powder.

REFERENCES:

1. Research Institute Nagpur Publication.
2. Standard Methods for Examination of Water and Wastewater - APHA, AWAA and WPCF, 2012 Edition.
3. Trivedhi and Goel. Chemical and Biological Methods for Water Pollution studies.
4. A Course manual – Water and Waste Water Analysis, national Environmental Engineering
5. http://web.iitd.ac.in/~arunku/files/CVL212_Y15/Lab_CVL212v1.pdf
6. http://www.citchennai.edu.in/wp-content/uploads/2015/02/CE2356-Environmental-Engineering.pdf

Course Coordinator **HOD**

U18MCAB509	**SELF DEVELOPMENT – SPIRITUAL, MINDFULNESS & MEDITATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: +2 Level Education				
	Course Coordinator Name & Department: Ms.Hemapriya, Civil Engineering				

COURSE OBJECTIVES: The objective of this Course is to make the students to know the importance of Spiritual, Mindfulness and Meditation in the daily life.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the Mind – Body Medicine.	P
CO2	To know about the meditation types.	O
CO3	To know about the effects of meditation.	P
CO4	To study how to manage the stress in daily life.	P

CO5	To know about the importance of developing theOptimism thoughts.	S
CO6	To develop optimism and balanced mindset.	S

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3			3		2		2		3	
	CO2		3				2				2				2
	CO3	3			3			3		2		2		3	
	CO4	2	3			2			2		2			3	2
	CO5		2	3				2					2	3	
	CO6	3								3		2			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I **6**

Theory and evidence behind the idea of mind-body medicine. Introduction to the basics of Mindfulness based stress Reduction (MBSR), including mindful eating, mindful breathing, and the body scan exercise.

UNIT II **6**

Spiritual meditation - Mindfulness meditation - Movement meditation - Focused Meditation- Visualization meditation-Chanting Meditation.

UNIT III **6**

Introduction toapplication of mindful practice to stressful situations - unhealthy or self-defeating patterns of thought, emotion, and behavior.

UNIT IV **6**

Interpersonal mindfulness, which applies to person-to-person communications, situations that can be accompanied by stress, anxiety, or other difficult emotions - practice of mindfulness into everyday life.

UNIT V **6**

Methods to develop optimism and balanced mindset. Exercise for Positive emotions.

TEXTBOOKS:

1. Elisha Goldstein and Bob Stahl, MBSR Every Day: Daily Practices from the Heart of Mindfulness-Based Stress Reduction 1st Edition, Kindle Edition.

REFERENCE BOOKS:

1. Bob Stahl (Author) and Florence Meleo-Meyer,A Mindfulness-Based Stress Reduction

2. Workbook, Kindle Edition.
3. Practice of Nature Cure - By Henry Lindlahr
4. History & Philosophy of Nature Cure - By S.J. Singh
5. My Nature Cure - By Sh. M. K. Gandhi
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5645519/
7. https://pdfs.semanticscholar.org/93e2/3b6797aa3e8e9c31d1fb6d0d5e551be299b9.pdf

Course Coordinator **HOD**

U18MCAB510	**SELF DEVELOPMENT – RELIGION AND INTER-FAITH**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: +2 Level Education				
	Course Coordinator Name & Department: Ms.R.Chitra, Civil Engineering				

COURSE OBJECTIVES: To gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about different religious faiths.	O
CO2	To know about philosophies issues.	M
CO3	To know about chronology issues.	M
CO4	To study the interfaith issues including contemporary situations worldwide.	GR
CO5	To acquire religious knowledge from scholars speech.	COR
CO6	To know about Reconciliatory Approaches.	O

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3				2				2				2
	CO2	3			3			3		2		2		3	
	CO3	3			3			3		2		2		3	
	CO4	2	3			2			2		2			3	2
	CO5	3		3		3			3		1		3	2	
	CO6		3							3		2			2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I **6**

A snapshot survey of World Religions; antiquity, diversity and graphical locations; Opening Questions related to the study of World Religions; critical methods; ambivalent, contradictory

and complementary paradigms.

UNIT II **6**

The Origin of Religion / The Evolutionists Approaches; Anthropological and Sociological Approaches; Reductive and Functionalist Approaches.

UNIT III **6**

Experiential Approaches: Phenomenological; Approaches to Mysticism; Psychoanalytical Approaches.

UNIT IV **6**

Symbolic Approaches; Exegetical and Hermeneutical Approaches.

UNIT V **6**

Feminism and Religion; Inter-faith dialogue and Reconciliatory Approaches.

TEXTBOOKS:

1. "Anthology of Living Religions" by Mary Pat Fisher, Lee W. Bailey, Pearson Publisher.
2. "Living Religions: A brief Introduction" by Mary Pat Fisher, Pearson Publisher.

REFERENCE BOOKS:

1. "On God Book" by J Krishnamurti, Krishnamurti Foundation India.
2. W.C. Smith. The Meaning and End of Religion.
3. Jan De Vries. The Study of Religion: A Historical Approach.
4. Josoph M. Kitagawa. History of Religions: Essays in Methodology.
5. Toynbee, Arnold J. Historical Approach to Religion.
6. G. Van der Leeuw. Religion in Essence and Manifestation.
7. M. Weber, "Sociology of Religion".
8. https://www.gmu.edu/programs/icar/ijps/vol1_1/smoker.html
9. https://www.tandfonline.com/doi/full/10.1080/00344087.2017.1383869

Course Coordinator **HOD**

SEMESTER VI

U18PCCE601	STRUCTURAL ANALYSIS – II	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Structural Analysis-I				
	Course Coordinator Name & Department: Ms.Hemapriya, Civil Engineering				

COURSE OBJECTIVES: To learn about the advanced theory and concepts of structural analysis and methods for the analysis of framed structures, indeterminate beams. To learn the concept of moving loads and influence line diagrams.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Analysis of continuous beams and Plane rigid frames with and without sway using Moment Distrubution Method.	An
CO2	Application to simple problems of beams and frames using stiffness matrix method	An
CO3	Application to simple problems of beams and frames using flexibility matrix method	An
CO4	Moving loads and Influence lines for determinate beams	Ap
CO5	Influence lines for Arches	C
CO6	To understand Influence lines for shear force and bending moment in beam sections	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3				2				2				2
	CO2	3			3			3		2		2		3	
	CO3	2	3			2			2		2			3	2
	CO4		3				2				2				2
	CO5	3			3			3		2		2		3	
	CO6	3			3			3		2		2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I MOMENT DISTRIBUTION METHOD 9

Distribution and carryover of moments – Stiffness and carry over factors – Analysis of continuous beams – Plane rigid frames with and without sway – Neylor‟s simplification

UNIT II FRAME ANALYSIS 9

Analysis of building frames - Kani's, moment distribution and other methods like substitute frame method and moment distribution method and other approximate methods.

UNIT III MATRIX METHODS 9

Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames by using flexibility and stiffness matrix methods

UNIT IV MOVING LOADS AND INFLUENCE LINES 12

Influence lines for reactions in statically determinate structures – influence lines for member forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads. Muller Breslau‟s principle – Influence lines for continuous beams and single storey rigid frames – Indirect model analysis for influence lines of indeterminate structures.

UNIT V ARCHES 6

Arches as structural forms – Examples of arch structures – Types of arches – Analysis of three hinged, two hinged and fixed arches, parabolic and circular arches – Settlement and temperature effects.

TEXT BOOKS:

1. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, “Theory of Structures”, Laxmi Publications, 2004.
2. Vaidyanathan, R. and Perumal, P., “Comprehensive structural Analysis – Vol. I & II”, Laxmi Publications, New Delhi, 2003
3. Negi L.S. & Jangid R.S., “Structural Analysis”, Tata McGraw Hill Publications, New Delhi, 2003.
4. BhavaiKatti, S.S, “Structural Analysis – Vol. 1 Vol. 2”, Vikas Publishing House Pvt. Ltd., New Delhi, 2008

REFERENCES:

1. Ghali.A, Nebille,A.M. and Brown,T.G. “Structural Analysis” A unified classical and Matrix approach” 6th edition. Spon Press, London and New York, 2013.
2. Pandit G.S. & Gupta S.P. “Structural Analysis – A Matrix Approach”, Tata McGraw Hill 2004.
3. William Weaver Jr. & James M. Gere, “Matrix Analysis of Framed Structures”, CBS Publishers and Distributors, Delhi, 2004.
4. https://nptel.ac.in/courses/105105109/
5. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_SA-II_LECTURE_NOTES.pdf

Course Coordinator **HOD**

U18PCCE602	**ESTIMATION & COSTING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**2**	**1**	**0**	**3**
	Prerequisite: Introduction to Civil Engineering				
	Course Coordinator Name & Department: Dr.A.Mani, Civil Engineering				

COURSE OBJECTIVES: To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

COURSE OUTCOMES (COs):		**Revised Bloom’s Taxonomy**
CO1	Able to use methods and type of estimates for calculating various items of works, required materials, quantities and cost of building estimate.	U

CO2	Preparing specification as per standards, calling and processing tenders.	Ap
CO3	Prepare contract documents with required contract conditions and to conduct arbritration to solve the disputes.	Ap
CO4	Calculate the rate for different items of works, recording measurements and preparing bills.	An
CO5	Assess the value of property, adopting price escalation and auditing	E
CO6	Drafting tender documents, preparing reports for estimation and publishimg notice inviting tendors.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		1			1		2		2		3		2
	CO2													2	
	CO3		1												2
	CO4	3			3			3		2		2		3	
	CO5	2	3			2			2		2			3	2
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I ESTIMATION **9**

Purpose – Methods of estimation – advantages – types of estimates – detailed estimates of residential buildings – single storied and multistoried buildings – earthwork – foundations – Super structure – Fittings including sanitary and electrical fittings – paintings.

UNIT II SPECIFICATIONS AND TENDERS **9**

Specifications – Detailed and general specifications – construction specifications – sources – types of specifications – Tender notices – types – corrigendum notice – tender procedures – Drafting model tenders

UNIT III CONTRACTS **9**

Contract – types of contracts – formation of contract – contract conditions – contract problems – contract for labor, material, design and construction – drafting of contract documents – construction contracts – arbitration and legal requirements.

UNIT IV RATE ANALYSIS AND PREPARATION OF BILLS **9**

Data – Rate analysis – abstract estimate – report to accompany estimate – measurement book – bills – types

UNIT V VALUATION **9**

Basic – Principles of valuation – Value and Cost – value engineering – value analysis – phases in value engineering – information – function – escalation – evaluation – recommendation implementation – Audit

TEXTBOOKS:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering (Theory & Practice)", UBS Publishers, 2016.
2. Birdie G.S. "A text book on estimating and costing" — Dhanpat Rai and Sons, New Delhi.

REFERENCE BOOKS:

1. M Chakraborti, " Estimating, Costing Specifications & Valuation in Civil Engineering",2010.
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand & Company Ltd., 2004
3. Jagannathan G, Getting more at less cost – The Value Engineering Way, Tata McGraw Hill, New Delhi, 1992.
4. https://www.slideshare.net/RANJITKUMARPANDA/estimating-andcosting-53811154
5. http://fmcet.in/CIVIL/CE6704_uw.pdf

Course Coordinator **HOD**

U18PCCE603	**PHYSICO – CHEMICALPROCESS FOR WATER AND WASTEWATER TREATMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department: Mr.Meikandaan, Civil Engineering				

COURSE OBJECTIVES: To educate the student on the working principles and design of various physical and chemical treatment systems for water and wastewater. To understand about design of industrial water treatment and reclamation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To learn the water purification in natural systems, physical processes, chemical processes and biological processes.	U
CO2	To understand about the Filtration: filtration processes, Hydraulics of flow through porous media.	U
CO3	To understand in detail about the water quality modeling process ,dissolved oxygen models and models on Groundwater	U
CO4	To improve the types of disinfectants, Kinetics of disinfection, chlorination and its theory and design.	C
CO5	To know about design of industrial water treatment and reclamation	C
CO6	To understad the principles of chemical treatment	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		1			3			2		3			2	2
	CO2	3			3			3		2		2		3	
	CO3	3		2			2				2		2	3	3
	CO4		3						3						
	CO5									2				1	2
	CO6	2	3				3					3	1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT-I INTRODUCTION 9

Pollutants in water and wastewater – characteristics, standards for performance – significant and need for physico – chemical treatment

UNIT-II PHYSICAL TREATMENT PRINICIPLES 9

Principles of screening – mixing, equalizations –sedimentation – filtration –backwashing – Adsorption-isotherms-principles - membrane separation, reverse osmosis, nano filtration- ultra filtration and hyper filtration – electro dialysis.

UNIT-III CHEMICAL TREATMENT PRINCIPLES 9

Principles of chemical treatment – coagulation -flocculation - Neutralisation - precipitation – floatation – disinfection -Ion exchange - advanced oxidation / reduction.

UNIT-IV CONVENTIONAL TREATMENT PLANTS 9

Conventional water treatment units –Screening – Types of aerators–chemical feeding – Methods - Mixing Devices - flocculation –clarifier – filters –rapid sand filter, slow sand filter, pressure filter-chlorinators.

UNIT-V INDUSTRIAL WATER TREATMENT AND RECLAMATION 9

Selection of process –design of softeners – demineralisers –wastewater reclamation –reverse osmosis plants –residue management – Operation and Maintenance aspects –recent advances .

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TEXT BOOKS:

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse Tata McGraw-Hill, New Delhi, 2010.
2. Manual on water supply and Treatment CPHEEO, Ministry of Urban Development ,GOI, New Delhi,1999.

REFERENCES:

1. Lee, CC and Shun dar Lin , Handbook of Environmental Engineering Calculations, McGraw- hill,Newyork , 2000.
2. Qasim,S.R motely, E.N., Zhu, G. Water Works Engineering – Planning, Design and Operation,Prentice Hall,New Delhi, 2002.
3. Casey, T.J.Unit Treatment Processes in Water and Wastewater Engineering, John Wiley and Sons, London2000.
4. https://drive.google.com/file/d/165EmQmwCMvH0e9arvHYW7WRyu1_6QlzW/view

Course Coordinator **HOD**

U18PCCE604	DESIGN OF STEEL STRUCTURES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Building Materials & Testing Methods				
	Course Coordinator Name & Department: Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: This course deals with some of the special aspects with respect to civil engineering structures in industries.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Design of plate girders, web and flange design, curtailment of flange plates.	C
CO2	Design of simple and built up columns subject to combined bending and axial loads	C
CO3	Design of flexural and compression members, Design of self supporting steel chimneys.	C
CO4	Design of overhead rectangular, cylindrical and pressed steel tanks	C
CO5	To study shape factor, plastic hinge ,plastic moment , plastic analysis of beams.	E
CO6	To understand the design concepts of gantry girders.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3			3		2		2		3	
	CO2	2	3			2			2		2			3	2
	CO3		3				2				2		3		2
	CO4		1			3			2		3			2	2
	CO5	3			3			3		2		2		3	
	CO6	3		2			2				2		2	3	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Properties of materials - loads and stresses - Design of semi-rigid, rigid and moment resistant connections.

UNIT II TENSION MEMBERS 9

Design of tension members - Built-up sections subjected to axial tension and bending -splicing of tension member.

UNIT III COMPRESSION MEMBERS 9

Design of compression members -Design of simple and built up columns subject to combined bending and axial loads - design of column base and connections to foundation – Beam-column.

UNIT IV BEAMS 9

Design of columns and their bases - Design of flexural members and Plate girder - loads, specification - Design Industrial buildings – Introduction to plastic analysis.

UNIT V ROOF TRUSSES AND INDUSTRIAL STRUCTURES 9

Loads, design of purlins, trusses, bracings - Gantry girders - All design steps/process to as per the most recent BIS code of practices

TEXT BOOKS:

1. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani.
2. Design of Bridges Structure by T.R.Jagadish & M.A.Jayaram Prentice Hall.
3. Design of Bridges by N.Krishnam Raju, Oxford & IBH, Publishing Ltd.

REFERENCES :

1. E.C Hambly, "Bridge Deck Behaviour", E & FN SPON Publications.
2. V.K. Raina , "Concrete Bridge Practice, Analysis, Design And Economics", Tata Mcgraw Hill
3. Publishing Company Limited.
4. R.Rajagopalan, "Bridge Superstructure", Tata Mcgraw- Hills Publishing Company Limited.
5. https://nptel.ac.in/courses/105106112/
6. https://nptel.ac.in/courses/105105162/
7. https://www.digimat.in/nptel/courses/video/105105162/L01.html

Course Coordinator **HOD**

	ESSENCE OF INDIA KNOWLEDGE TRADITION	L	T	P	C
U18MCTH603	Total Contact Hours: 30	**2**	**0**	**0**	**0**
	Prerequisite: Nil				
	Course Coordinator Name & Department: Ms.Chitra, Civil Engineering				

COURSE OBJECTIVES: It will also focus on Indian philosophical, linguistic and artistic traditions, along with yoga and Indian perspective of modern scientific worldview. The course aims at imparting basic principles of thought process, reasoning and inferencing.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To develop the physical and social contexts in traditional knowledge	C

CO2	To understand the need for protecting traditional knowledge	U
CO3	The know Scheduled Tribes and Other Traditional Forest Dwellers	U
CO4	To get knowledge on Legal concepts for the protection of tradition	U & R
CO5	To learn the Importance of conservation and sustainable development of environment	U
CO6	To learn the differences in traditional knowledge Vs western knowledge	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3					2		1			2		1	3
	CO2		2										3		
	CO3			1						2				2	
	CO4	1	3				2				2		3		2
	CO5		1			3			2		3			2	2
	CO6	3			3			3		2		2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: INTRODUCTION TO TRADITIONAL KNOWLEDGE 6

Define traditional knowledge, nature andcharacteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II: PROTECTION OF TRADITIONAL KNOWLEDGE 6

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III: LEGAL FRAME WORK AND TK 6

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

UNIT IV: TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 6

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase

protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V: TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Course Coordinator **HOD**

	ESTIMATION & COSTING LABORATORY	**L**	**T**	**P**	**C**
U18PCCE6L1	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: Computer aided Civil Engineering DrawingLaboratory				
	Course Coordinator Name & Department: Mr.Meikandaan, Civil Engineering				

COURSE OBJECTIVES: To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Will have a basic knowledge on application of quantity estimation software.	COR
CO2	Will have the knowledge of rate analysis of different items of work.	COR
CO3	Will have the knowledge of detailed estimation of residential buildings	COR
CO4	Will have the knowledge of bill of quantities	COR
CO5	Will able to value a property, price escalation recommendations and auditing	COR & GR
CO6	To learn estimation for long and short wall method	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3			2		2		2		3	
	CO2		3				2				2		3		2
	CO3	3	1			3			2		3			2	2
	CO4	3			3			3		2		2		3	
	CO5		3												1
	CO6	1				2			1				2	1	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	**Professional Core (PC)**	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

LIST OF EXPERIMENTS

1. Estimation of Compound wall.
2. Estimation of building by using long wall method.
3. Estimation of building by using short wall method.
4. Rate Analysis of Earthwork Excavation.
5. Rate Analysis of PCC.
6. Rate analysis of Brickwork.
7. Rate analysis of RCC work in Beams.
8. Rate analysis of RCC work in Slabs.
9. Rate analysis of RCC work in Columns.
10. Rate Analysis of Plastering.

REFERENCES:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering (Theory & Practice)", UBS Publishers, 2016.
2. G.S.Birdie, " A text book on estimating and costing" Dhanpat Rai and Sons, New Delhi, 2014.
3. https://www.slideshare.net/alihyder790/rates-analysis
4. https://www.scribd.com/document/155339519/civil-engineering-Rate-Analysis

Course Coordinator **HOD**

U18MCAB611	**SOCIAL SERVICES – SOCIAL AWARENESS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: Literature & Media –Literature, Cinema & Media				
	Course Coordinator Name & Department: Dr. Venkata Krishnaiah, Civil Engineering				

COURSE OBJECTIVES: To acquire an understanding and knowledge of the history and philosophy of Social Work and its emergence as a Profession.To appreciate Social Work as a Profession and to recognize the need and importance of Social Work Education, Training and Practice.To provide an awareness of various methods and Fields of Professional Social Work Practice.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To understanding and knowledge of social service and social welfare.	P
CO2	To know about Historical development of Social Work.	O
CO3	To understand about social work profession.	GR
CO4	To know about Indian Constitution and its implication of Social Welfare.	O
CO5	To understand about Role of Voluntary Organizations and emerging trends	COR
CO6	To learn Principles, Philosophy and values and Code of Ethics of Social Work Profession	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

2	CO1	3					2				2			2	2
	CO2			2						2					
	CO3	3			3			2		2		2		3	
	CO4		3				2				2		3		2
	CO5		3				2				2		3		2
	CO6	3	1			3			2		3			2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I SOCIAL WORK 6

Concept, Definition, Objectives and Scope – Basic Concepts in Social Work : Social Service, Social Welfare, Social Assistance, Social Development, Social Security, Social Justice, Social Reform, Social Defense, Social Policy, Social Legislation, Social Education, Social Inequality, Social Organization and Social Disorganization.

UNIT II HISTORICAL DEVELOPMENT OF SOCIAL WORK IN UK, USA AND INDIA 6

Social Work Literature - Contribution of Indian Social Reformers to Social Welfare – Contribution of Social Reformers to Social Welfare in Tamil Nadu - Social Movements – Religio - Philosophical foundation of Social Work Practice in India. - Gandhi an Philosophical Foundation to Social Work in India.

UNIT III SOCIAL WORK PROFESSION 6

Origin and Growth of Social Work in India - Principles, Philosophy and values and Code of Ethics of Social Work Profession - Social work profession as a change agent-Integrated social work and place in social work practice - Fields and Methods of Social Work – Roles and Skills of Social Worker. Social Work Education: Evolution of Social Work Education- Social Work Curriculum.

UNIT IV INDIAN CONSTITUTION & ITS IMPLICATION OF SOCIAL WELFARE 6

Fundamental Rights Part -III, Fundamental Duties Part-IV A, Directive principles of State Policy Part-IV, Human Rights**,** According to U.N Charter and Indian Constitution.

UNIT V VOLUNTARY ORGANIZATION 6

Role of Voluntary Organizations and emerging trends - Voluntary Social Work: Role of Government and Voluntary Organizations in promoting Social Welfare - Changing trends in social work and the role of social worker and the government in promotingsocial work profession in India.

TEXT BOOKS:

1. Batra, Nitin (2004) Dynamics of Social Work in India, Jaipur : Raj Publishing House.
2. Bradford, W. Sheafor, Charles, R. Horejsi, Gloria A. - Fourth Edition Techniques and Guidelines for Social Work, London : Allyn and Bacon, A Viacom Company.

3. Dasgupta, Sugata Towards a Philosophy of Social Work in India, New Delhi : Popular Book Services.

REFERENCES:

1. Charles, Guzzetta, Katz Arthur J. and English Rechard A. (1984) Education for Social Work Practice, Selected International Models, New York : Council on Social Work Education
2. Desai, Murali (2002) Ideologies and Social Work (Historical and Contemporary Analysis),Jaipur : Rawat Publication.
3. Diwakar, V. D. (1991) Social Reform Movement in India, Mumbai : Popular Prakashan
4. Dubois, Brenda, Krogsrud, Karla, Micky - Third Edition (1999) Social Work - An Empowering Profession, London : Allyn and Bacon.

Course Coordinator **HOD**

U18MCAB612	**SOCIAL SERVICES – NSS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: Literature & Media –Literature, Cinema & Media				
	Course Coordinator Name & Department: Mr.Meikandaan, Civil Engineering				

COURSE OBJECTIVES: To Understand the community in which they work and their relation. Identify the needs and problems of the community and involve them in problem-solving. Develop capacity to meet emergencies and natural disasters. Practice national integration and social harmony and Utilize their knowledge in finding practical solutions to individual and community problems.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Understand the community in which they work and their relation	GR
CO2	To Identify the needs and problems of the community and involve them in problem-solving	GR
CO3	To Develop capacity to meet emergencies and natural disasters	GR
CO4	To Practice national integration and social harmony	A
CO5	To Utilize their knowledge in finding practical solutions to individual and community problems.	P
CO6	To learn the use of the mass media in the N.S.S. activities.	GR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				1					2		1		1
	CO2		2						1					2	
	CO3			1							1				3
	CO4	3			3			2		2		2		3	
	CO5		3				2				2		3		2
	CO6	3			3			2		2		2		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: NATIONAL SERVICE SCHEME 6

History and its Objectives-Organizational structure of N.S.S. at National, State, University and College Levels-Advisory committee and their functions with special reference to college principal, Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

UNIT II: NATIONAL INTEGRATION 6

Need of National integration-Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.

UNIT III: SPECIAL PROGRAMME 6

Legal awareness-Health awareness-First-aid-Career guidance-Leadership training - cum - Cultural Programme-Globalization and its Economic Social Political and Cultural impacts,

UNIT IV: SPECIAL CAMPING PROGRAMME 6

Nature and its objectives-Selection of camp site and physical arrangement-Organization of N.S.S. camp through various committees and discipline in the camp-Activities to be undertaken during the N.S.S. camp-Use of the mass media in the N.S.S. activities.

UNIT V: N.S.S. REGULAR ACTIVITIES 6

Traffic regulation-Working with Police Commissioner's Office-Working with Corporation of Chennai-Working with Health Department-Blind assistance-Garments collection-Non-formal education-Environmental Education, Awareness and Training (EEAT)'-Blood donation.

TEXT BOOKS:

1. National Service Scheme Manual, Government of India,2006.
2. Training Programme on National Programme scheme, TISS.
3. Orientation Courses for N.S.S. Programme officers, TISS.

REFERENCES:

1. Case material as Training Aid for field workers, Gurmeet Hans.
2. Social service opportunities in Hospitals, Kapil K.Krishan,TISS.
3. Social Problems in India, Ram Ahuja, 2014.

Course Coordinator HOD

SEMESTER VII

U18PCCE701	DISASTER PREPAREDNESS & PLANNING MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department: Mr.P.Dayakar, Civil Engineering				

COURSE OBJECTIVES: The overall aim of this course is to provide broad understanding about the basic concepts of Disaster Management with preparedness as a Civil Engineer. Further, the course introduces the various natural hazards that can pose risk to property, lives, and livestock, etc.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Understand basic concepts in Disaster Management	U
CO2	To Understand Definitions and Terminologies used in Disaster Management	U
CO3	To Understand Types and Categories of Disasters	U
CO4	To Understand the Challenges posed by Disasters	U
CO5	To understand Impacts of Disasters Key Skills	U
CO6	To gain knowledge on sustainable and environmental friendly development methods	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3				2				2		3		2
	CO2		3				2				2		3		2
	CO3	3	1			3			2		3			2	2
	CO4		3				2			2	2		3		2
	CO5	3				1					2		1		1
	CO6		2						1					2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

UNIT 1: INTRODUCTION **9**

Introduction-Concepts and definitions: disaster, hazard, vulnerability, risks-severity, frequency and details, capacity, impact, prevention, mitigation).

UNIT II: **DISASTERS CLASSIFICATION** **9**

Disasters-Disasters classification; natural disasters (floods, draught, cyclones,volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III: **DISASTER IMPACTS** **9**

Disaster Impacts-Disaster impacts (environmental, physical, social, ecological,economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT IV: DISASTER MANAGEMENT **9**

Disaster Risk Reduction (DRR)-Disaster management cycle – its phases;prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNITV: DISASTER RECOVERY **9**

Disasters, Environment and Development-Factors affecting vulnerability such asimpact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

TEXT BOOKS:

1. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
3. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

REFERENCE:

1. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of
2. California, EMSA no.214, June 2003
3. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
4. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
5. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).

Course Coordinator **HOD**

U18PCCE702	PROFESSIONAL PRACTICE LAW &	L	T	P	C

	ETHICS				
	Total Contact Hours: 30	**2**	**0**	**0**	**2**
	Prerequisite: Estimation & Costing				
	Course Coordinator Name & Department: Mr.Anish.C, Civil Engineering				

COURSE OBJECTIVES: To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession. To develop some ideas of the legal and practical aspects of their profession.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To familiarise the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession	Ap
CO2	To give a good insight into contracts and contracts management in civil engineering, dispute resolution mechanisms; laws governing engagement of labour.	U
CO3	To give an understanding of Intellectual Property Rights, Patents.	U
CO4	To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession.	U
CO5	To develop good ideas of the legal and practical aspects of their profession.	R
CO6	To get knowledge on labour & other construction-related laws	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				1					2		1		1
	CO2		2						1					2	
	CO3		3				2				2		3		2
	CO4		3				2				2		3		2
	CO5	3	1			3			2		3			2	2
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I PROFESSIONAL PRACTICE & ETHICS 6

Respective roles of various stakeholders: Government,Standardization Bodies (ex. BIS, IRC) professional bodies (ex. Institution of Engineers(India), Clients/ owners, Developers Consultants Contractors, Manufacturers/ Vendors/ Service agencies,Definition of Ethics, Professional Ethics, Business Ethics,Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India);

Profession, Professionalism, Professional Responsibility, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing,

protected disclosures.

UNIT II GENERAL PRINCIPLES OF CONTRACTS MANAGEMENT 6

Indian Contract Act, 1972 andamendmentscovering General principles of contracting; Contract Formation & Law; Privacyof contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium;; Tenders, Request For Proposals, Bids & Proposals; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Contract documentation; Contract Notices.

UNIT III ARBITRATION 6

Arbitration – meaning, scope and types - Arbitration and expert determination; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement,Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality.

UNIT IV LABOUR & OTHER CONSTRUCTION-RELATED LAWS 6

Role ofLabour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

UNIT V LAW RELATING TO INTELLECTUAL PROPERTY 6

Meaning of intellectualproperty, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright, Ownership of copyrights and assignment, Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Process of obtaining patent – application, examination, opposition and sealing of patents,Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

TEXT BOOKS

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset

REFERENCE:

1. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
2. Avtarsingh (2002), Law of Contract, Eastern Book Co.
3. Dutt (1994), Indian Contract Act, Eastern Law House
4. Anson W.R. (1979), Law of Contract, Oxford University Press

5. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India, Indian Council of
6. Arbitration. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
7. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
8. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/110105097/lec1.pdf
9. https://nptel.ac.in/courses/110105097/
10. http://ethics.iit.edu/publication/CODE--Exxon%20Module.pdf

Course Coordinator **HOD**

U18PCCE703	**TRANSPORTATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**2**	**0**	**0**	**2**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department: Ms.Hemapriya, Civil Engineering				

COURSE OBJECTIVES: To give an overview about the highway engineering with respect to, planning, design, construction and maintenance of highways as per IRC standards, specifications and methods.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To carry out surveys involved in planning and highway alignment	E
CO2	To design the geometric elements of highways and expressways	C
CO3	To carry out traffic studies and implement traffic regulation and control measures and intersection design.	E
CO4	To characterize pavement materials.	An
CO5	To design flexible and rigid pavements as per IRC.	C
CO6	To get knowledge on Materials used in Highway Construction	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2			3					3			3	
	CO2														3
	CO3			3					3		2			3	
	CO4	3				1					2		1		1
	CO5		2						1					2	
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I HIGHWAY DEVELOPMENT AND PLANNING 6

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – Classification of highways – Locations and functions – Factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 6

Typical cross sections of Urban and Rural roads — Cross sectional elements - Sight distances – Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

UNIT III TRAFFIC ENGINEERING & CONTROL 6

Traffic Characteristics, traffic engineering studies,traffic flow and capacity, traffic regulation and control; design of road intersections; design ofparking facilities; highway lighting; problems,Intelligent Transport System For Traffic Management, Enforcement And Education.

UNIT IV PAVEMENT MATERIALS 6

Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems

UNIT V DESIGN OF PAVEMENTS 6

Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

TEXT BOOKS:

1. Transportation Engineering, Kadiyali, (ISBN: 978-81-87325-72-7), Khanna Book Publishing Co. (P) Ltd., Delhi,2016
2. Highway Engineering, Khanna & Justo, Nemchand & Bros,2015.

REFERENCE

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.
2. Principles of Transportation Engineering, Chakrobarty, PHI Learning,2003.
3. https://nptel.ac.in/courses/105101087/
4. https://nptel.ac.in/courses/105101008/
5. https://nptel.ac.in/courses/105107123/

Course Coordinator HOD

U18PCCE7P1	**PROJECT I – (Mini Project)**	**L**	**T**	**P**	**C**
	Total Contact Hours: 90	**0**	**0**	**6**	**3**
	Prerequisite: Environmental Science, Professional core & Professional Elective				
	Course Coordinator Name & Department: Dr.A.Mani, Civil Engineering				
COURSE OBJECTIVES: To provide exposure to the studentsto do projects based on identification of the problem based on the literature review on the topic referring to latest literature available.					
COURSE OUTCOMES (COs):					**Revised Bloom's Taxonomy**

CO1	To identify the area of research.	P
CO2	To prepare list of literatures in the relevant area.	O & P
CO3	Compile the abstract from the literatures.	M
CO4	Focus the search to a well defined theme and title.	A
CO5	Make and exhaustive report by compiling all the literatures those students surveyed.	P & M
CO6	To carry out the experimental investigations according to methodology,	GR & COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2	3				3		3	2		3	3
	CO2						3			2					
	CO3		3				2			2	2		3	3	2
	CO4	3	1	2		3			2		3	2		2	2
	CO5		3				2				2		3		2
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	**Employment Enhancement Courses (EEC)**	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF TASKS

1. **PREPARING PROPOSAL**
   Proposed Research Topic
   Purposes
   Background
   Method: (suggested methods – develop your own to suit your research topic)

2. **CONDUCTING LITERATURE REVIEW**
   Exploring and Sharpening your Topic
   Evaluating Information
   Taking Notes and Keeping Records

3. **COMPLETING ANNOTATED BIBLIOGRAPHY**
   Citing Your Sources and Avoiding Plagiarism
   Writing and Annotated Bibliography

4. **IDENTIFYING PROBLEM STATEMENT**
   Meeting the Challenges of Research
   Developing New Information

5. **COMPLETING OUTLINE FOR THE RESEARCH**
   Organizing Your Project into an outline

Pick up your critique paper and begin editing and incorporate the suggestions from guide

6. **SUBMITTING FIRST DRAFT**
   Drafting your Project
   Entering Conversations and Supporting Your Claims

7. **SUBMITTING WORKS CITED**
   Create the individual citations
   Apply the formatting rules

8. **SUBMITTING FULL PAPER**
   Revising, Editing, and Proofreading
   Designing and Presenting Your Project
   Conducting Research in the Disciplines
   Documenting Sources

REFERENCES:

1. Website.
2. Printed Journals.

Mini Project will have mid semester presentations and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment ofMini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Course Coordinator **HOD**

U18PCCE0T1	**TERM PAPER**	**L**	**T**	**P**	**C**
	Total Contact Hours: 15	**0**	**0**	**2**	**1**
	Prerequisite: Construction Technoloy				
	Course Coordinator Name & Department: Mr.P.Dayakar, Civil Engineering				

COURSE OBJECTIVES: To obtain knowledge from the industries, to develop team spirit, coordinating with higher officials and to know about importance of field activities.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To identify the area of research.	P
CO2	To prepare list of literatures in the relevant area.	O
CO3	Compile the abstract from the literatures.	M
CO4	Focus the search to a well defined theme and title.	A
CO5	Make and exhaustive report by compiling all the literatures that students surveyed.	P & M
CO6	To carry out the experimental investigations according to methodology,	GR & COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3				3			2	2		3	3	2
	CO2	3	1	2		3			2		3	2		2	2
	CO3														
	CO4	1	2						2		2			3	
	CO5		3				2			2	2		3	3	2
	CO6	3	1	2		3			2		3	2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	**Employment Enhancement Courses (EEC)**	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

SYLLABUS

The student shall submit a brief report on the training undergone and a certificate from the organization concernedat the end of Industrial / Practical training / internship / Summer Project. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department.

Course Coordinator **HOD**

U18PCCE0C1	**COMPREHENSION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**1**
	Prerequisite: All the Professional courses upto VI semester				
	Course Coordinator Name & Department: Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: To provide a complete review of Civil Engineering topics covered up to VI semesters, so that a comprehensive understanding is achieved.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To get familiarize with subject core.	A
CO2	To understand the principle concepts in all subjects	P & S
CO3	To acquire knowledge in formulas and its applications	M
CO4	To understand the clarity of choices.	S
CO5	To recollect the concept of all subjects.	M
CO6	To differentiate the purpose and needs for all core subjects.	P

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2	3				3		3	2		3	3
	CO2						3			2					
	CO3		3				2			2	2		3	3	2
	CO4	3	1	2		3			2		3	2		2	2
	CO5		3				2				2		3		2
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	**Employment Enhancement Courses (EEC)**	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

SYLLABUS

The comprehension course is offered to recollect the concepts of all the core subjects from Semester II to Semester VI. Test will be conducted at the end of the semester and evaluated by a written test.

Course Coordinator **HOD**

U18MCAB713	**BEHAVIORAL AND INTERPERSONAL SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: Culture learning an art form				
	Course Coordinator Name & Department: Ms.Mariasubhashini, Civil Engineering				

COURSE OBJECTIVES: The objective of this course is to make the students aware Motivational lectures, Group Discussions/activities, Case Study, Games/Stimulation Exercises, Role-Playing, Mindfulness training.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To help the students to understand their real self by recognizing different aspects of their self-concept that will lead to an increased self-confidence.	S
CO2	To train the students for communicating effectively in both formal as well as in informal settings.	GR
CO3	To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work	GR
CO4	To help the students to understand the importance of non-verbal aspects of effective communication.	GR
CO5	To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.	COR
CO6	To empower themselves to be the source of their own growth and development.	COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3				2			2	2		3	3	2
	CO2	3	1	2		3			2		3	2		2	2
	CO3		3				2				2		3		2
	CO4		1			3					1			3	2
	CO5	3		2	3				3		3	2		3	3
	CO6						3			2					

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

SYLLABUS **30**

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

Course Coordinator **HOD**

U18MCAB714	**NATURE – NATURE CLUB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**0**
	Prerequisite: NSS				
	Course Coordinator Name & Department: Mr.Rajesh, Civil Engineering				

COURSE OBJECTIVES: The objective of this course is to Search and explore patents and rights related to animals, trees etc.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Identify a tree fruit flower peculiar to a place or having origin from the place	GR
CO2	Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc	COR
CO3	People can recognize games on recognizing animals/plants	P
CO4	Videography/ photography/ information collections on specialties/unique features of different types of common creatures	GR
CO5	Studying miracles of mechanisms of different body systems	M
CO6	To appreciate the difference in the local biodiversity .	P

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2	3				3		3	2		3	3
	CO2						3			2					
	CO3		3				2			2	2		3	3	2
	CO4	3	1	2		3			2		3	2		2	2
	CO5		3				2				2		3		2
	CO6		3				2				2		3		2
3	Category	Humanities & Social Sciences including Management Courses (HS)		Basic Sciences (BS)		Engg. Sciences (ES)	Professional Core (PC)		Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)		**Mandatory Courses (MC)**	
4	Approval	Meeting of Academic Council, May 2018													

SYLLABUS **30**

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Course Coordinator **HOD**

SEMESTER VIII

U18PCCE8P2	PROJECT - 2	L	T	P	C
	Total Contact Hours: 270	0	0	18	9
	Prerequisite: Environmental Science, Professional core & Professional Elective				
	Course Coordinator Name & Department: Dr.A.Mani, Civil Engineering				

COURSE OBJECTIVES: To provide exposure to the studentsto do projects based on identification of the problem based on the literature review on the topic referring to latest literature available.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To identify the area of research.	P
CO2	To prepare list of literatures in the relevant area.	O & P
CO3	Compile the abstract from the literatures.	M
CO4	Focus the search to a well defined theme and title.	A
CO5	Make and exhaustive report by compiling all the literatures that students surveyed.	P & M
CO6	To carry out the experimental investigations according to methodology,	GR & COR

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2	3				3		3	2		3	3
	CO2						3			2					
	CO3		3				2			2	2		3	3	2
	CO4	3	1	2		3			2		3	2		2	2
	CO5		3				2				2		3		2
	CO6		3				2				2		3		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	**Employment Enhancement Courses (EEC)**	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

LIST OF TASKS

1. **PREPARING PROPOSAL**
   Proposed Research Topic
   Purposes
   Background
   Method: (suggested methods – develop your own to suit your research topic)

2. **CONDUCTING LITERATURE REVIEW**
   Exploring and Sharpening your Topic
   Evaluating Information
   Taking Notes and Keeping Records

3. **COMPLETING ANNOTATED BIBLIOGRAPHY**
   Citing Your Sources and Avoiding Plagiarism
   Writing and Annotated Bibliography

4. **IDENTIFYING PROBLEM STATEMENT**
   Meeting the Challenges of Research
   Developing New Information

5. **COMPLETING OUTLINE FOR THE RESEARCH**
   Organizing Your Project into an outline
   Pick up your critique paper and begin editing and incorporate the suggestions from guide

6. **SUBMITTING FIRST DRAFT**
   Drafting your Project
   Entering Conversations and Supporting Your Claims

7. **SUBMITTING WORKS CITED**
   Create the individual citations
   Apply the formatting rules

8. **SUBMITTING FULL PAPER**
   Revising, Editing, and Proofreading
   Designing and Presenting Your Project
   Conducting Research in the Disciplines
   Documenting Sources

REFERENCES:

1. Website.
2. Printed Journals.

Mini Project will have mid semester presentations and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment ofMini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Course Coordinator **HOD**

U18MCAB815	INNOVATION–PROJECT BASED– Sc., TECH, SOCIAL, DESIGN & INNOVATION	L	T	P	C
	Total Contact Hours: 30	0	0	2	0
	Prerequisite: Nil				
	Course Coordinator Name & Department: Mr.P.Dayakar, Civil Engineering				

COURSE OBJECTIVES: The students should be encouraged to undertake technology projects of social relevance.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Students may be encouraged to take up projects which are aimed at providing solutions to societal problems	COR
CO2	To reduce drudgery and improving efficiency in rural work	COR
CO3	To adopt to green technologies, utilization of rural and urban waste	A
CO4	To encourage sanitation and public health, utilizing	GR
CO5	Use of non -conventional energy sources	M
CO6	To work with prototype models.	A

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	3		2		3			2		2			3
	CO2		3				2			2	2		3	3	2
	CO3	3	1	2		3			2		3	2		2	2
	CO4	1		2				3			1		1		
	CO5	3		2	3				3		3	2		3	3
	CO6						3			2					1

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	Professional Core Elective (PE)	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	**Mandatory Courses (MC)**
4	Approval	Meeting of Academic Council, May 2018								

SYLLABUS **30**

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Course Coordinator **HOD**

LIST OF PROFESSIONAL ELECTIVE COURSES

PROFESSIONAL ELECTIVE - I (PE – I)

U18PECE011	**INFRASTRUCTURE PLANNING AND DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: This course focuses on the physical infrastructure systems that support society, including transportation, communications, power, water, and waste. To get idea about public private sector participation in infrastructure projects.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To get a basic knowledge about infrastructure planning.	Ap
CO2	To know the rise in demands in infrastructure.	U
CO3	To learn the forecasting techniques.	U
CO4	To identify the areas of development.	An
CO5	To understand the evaluation concepts of risk management .	U
CO6	To understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		3			3		1	2		2		2	2
	CO2										2				
	CO3	2	3		1		2			2	2		3	3	2
	CO4	3	1	2		3			2		3	2		2	2
	CO5		3				2				2		3		2
	CO6		1			3			2		1			3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BASICS OF INFRASTRUCTURE 9

Introduction – Definition of basic terminologies, role of infrastructure in economic development, types of infrastructure, measurement of infrastructure capacity - bases for quantification of demand and supply of various types of infrastructure - Indian scenario – adequacy and quality, Infrastructure planning – goals & objectives.

UNIT II DEMAND FOR INFRASTRUCTURE 9

Identification and quantification – demand for infrastructure – application of techniques to estimate supply – use of econometric, social and land use indicators – forecast on demand and service of infrastructure – impact on land use.

UNIT III FORECASTING TECHNIQUES IN INFRASTRUCTURE 9

Views in forecasting techniques - identify and prioritize areas of development, Integration of strategic planning – infrastructure at urban, regional and national levels – case studies in infrastructure planning.

UNIT IV: EVALUATION OF INFRASTRUCTURE INVESTMENTS 9

Infrastructure Management: Concepts, Common aspects of urban and rural infrastructure management systems; pavement and bridge management systems, Integrated infrastructure management.

UNIT V CASE STUDIES 9

Emerging trends in infrastructure: Overview of Public-Private Sector Participation in infrastructure projects, Understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects, public policy for infrastructure Sectoral Overview: Highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply, sanitation – case study examples.

TEXTBOOKS:

1. Alvin S. Goodman and Makarand Hastak, "Infrastructure Planning Engineering and Economics, McGraw – Hill Publications, Second edition, 2015.
2. James Parkin and Deepak Sharma, ICE Publishing, 2015.
3. De Neufville (1990) Applied Systems Analysis: Engineering Planning and Technology Management. McGraw-Hill Publishing Company. Chapters 1-6.
4. De Neufville (1990) Applied Systems Analysis: Engineering Planning and Technology Management. McGraw-Hill Publishing Company. Chapters 10-13.

REFERENCE:

1. Deepty Jain, Geetam tiwari, "NMT Infrastructure in India: Investment, Policy and Design", federal Ministry for the Environment, Federal Republic of Germany 2013.
2. Goodman and Hastak, "Infrastructure Planning Handbook: Planning, Engineering, and Economics. McGraw Hill / ASCE Press. Chapter 1 2006.

3. Sanhita Sapatnekar, Ila Patnaik and Kamal Kishore, "Regulating Infrastructure Development in India",www.nipfp.org.in/publications/working-paper.
4. nptel.ac.in/courses/105106115
5. nptel.ac.in/content/syllabus_pdf/105106188.pdf

Course Coordinator **HOD**

U18PECE012	**REPAIR & REHABILITATION OF STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To get the knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about Maintenance and Repair Strategies.	U
CO2	To know about the Strength and Durability Of Concrete.	U
CO3	To learn the about Special types of Concrete.	R
CO4	To learn about techniques for Repair and Protection Methods.	R
CO5	To learn about Non-Destructive testing systems.	R
CO6	To understand the difference in Repair, Rehabilitation and Retrofitting of Structures	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		3			3				3			3	
	CO2		2			2			1				2		3
	CO3	1									2				
	CO4		3				2			2	2		3	3	2
	CO5	3	1	2		3			2		3	2		2	2
	CO6	1		2				3			1		1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance and Repair Strategies Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration;

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Strength and Durability Of Concrete- Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness;

UNIT III SPECIAL CONCRETES

Special Concretes- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes;

UNIT IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS 9

Techniques for Repair and Protection Methods- Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection; Repair, Rehabilitation and Retrofitting of Structures- Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting;

UNIT VREPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs. Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques – Engineered demolition methods – Case studies.

TEXT BOOKS:

1. Concrete Structures Repair Rehabilitation and Retrofitting, J.Bhattacharjee, 2017.
2. Building Repair And Maintenance Management, Gahlot P. S, 2006.
3. Repair and Rehabilitation of Concrete Structures, 2016by Poonam I. Modi, Chirag N. Patel.

REFERENCES:

1. Dodge Woodson.R,"Concrete Structures – protection, repair and rehabilitation", Elsevier Butterworth – Heinmann, UK, 2009.
2. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd., 2001.
3. www.thefreedictionary.com/repa
4. www.merriam-webster.com/dictionary/repair

Course Coordinator **HOD**

U18PECE013	**RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To educate the students on the principles of rural water supply and sanitation and to develop understanding of factors governing the aspects in rural water supply and sanitation. Design of septic tanks single pit and double pit toilet.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Study the need for water treatment	U
CO2	Understand the concept of water treatment system.	U

CO3	Understand in detail about the Basic requirement of sanitation	U
CO4	Study about the biological treatment system	R
CO5	Know about the sewage disposal and recycle of sewage	U
CO6	To learn Salt water intrusion and remediation process.	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	1	2		3			2		3	2		2	2
	CO2	1		2				3			1		1		
	CO3	3		2	3				3		3	2		3	3
	CO4						3			2					1
	CO5	3		3			3				3			3	
	CO6		2			2			1				2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNITI NEED FOR WATER TREATMENT 9

Attributes of water supply systems, drinking water quality. Relationships between diseases and water quality, hygiene and sanitation. Need for water treatment.

UNITII WATERTREATMENT 9

Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron. Onsite sanitation systems.

UNITIII SANITATION 9

Basic requirement of sanitation; Decentralized / onsite wastewater management; small bore / settled effluent sewer system – Design and operation.

UNITIV SEWAGE TREATMENT 9

Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets. Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.

UNITV SEWAGE DISPOSALAND REUSE 9

Methods of disposal, Land disposal, sewage farms – Artificial recharge of ground water; Recycle and Reuse of sewage – Grey water Harvesting – Salt water intrusion and remediation – Ground water pollution and remediation.

TEXT BOOKS:

1. Metcalf & Eddy, Wastewater Engg. Treatment and Reuse, Tata McGraw Hill, New

Delhi (2003).
2. Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York(2000).
3. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations CRC Press, New York(2009).

REFERENCES:

1. CPHEEO Manual on Water Supply and Treatment, Govt. of India(2003).
2. CPHEEO Manual on Sewerage and Sewage Treatment, Govt. of India(1999).
3. www.izito.ws/**Water Systems**
4. lecturenotes.in/notes/3319-notes-for-water

Course Coordinator **HOD**

U18PECE014	**ENVIRONMENTAL FLUID MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Fluid Mechanics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyze and appreciate the complexities involved in solving the fluid flow problems. To introduce the basics of hydrostatic forces involved in fluid mechanics and also to acquaint the students to learn about the theorems on Pascal's law and buoyancy.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To learn about the basics of fluid mechanics and various properties of fluids	U
CO2	To learn about the various forces on plane and curved surfaces and the concepts of buoyancy	U
CO3	To have a clear understanding about fluid kinematics and dynamics	U
CO4	To study the basics of boundary layer flow and flow through pipes	R
CO5	To study about various models like distorted models and various dimensionless numbers	R
CO6	To understand the concepts of Rayleigh's method and Buckingham PI-Theorem	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3					3			2			3		3
	CO2		2								1			2	
	CO3	2	3		2		3			2		2			3
	CO4		3				2			2	2		3	3	2
	CO5	3	1	2		3			2		3	2		2	2
	CO6	1		2				3			1		1		

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I DEFINITIONS &FLUID PROPERTIES 8

Definitions – Fluid and Fluid Mechanics – Dimensions and units – Fluid properties continuum Concept of system and control volume.

UNIT II FLUID STATICS 8

Pascal's law and hydrostatic equation – Forces on plane and curved surfaces – Buoyancy-Pressure measurement.

UNIT III FLUID DYNAMICS & KINEMATICS 11

Fluid Kinematics - Stream, steak and path lines, Classification of flows-continuity equation, Stream and Potential functions, Flow nets, Velocity measurement. Euler and Bernoulli's equations- Application of Bernoulli's equation-Discharge measurement-laminar flows through pipes and between plates – Hagen Poisuille equation – Turbulent flow, DancyWeisbach formula - moody Diagram – Momentum Principle- Impact of jets on plane and curved plates.

UNIT IV BOUNDARY LAYER AND FLOW THROUGH PIPES 9

Definition of boundary layer – Thickness and classification - Displacement and momentum thickness. Development of laminar and Turbulent flows in circular pipes, Major and Minor losses of Flow in Pipes in series and in parallel pipe network.

UNIT V SIMILITUDE AND MODEL STUDY 9

Dimensional analysis – Rayleigh's method – Buckingham PI-Theorem- Similitude and Models – Scale effect and distorted models.

TEXT BOOKS

1. Kumar K.L "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi.

REFERENCES

1. Streeter, Victor, L, and Benjamin., "Fluid Mechanics", McGraw-Hill Ltd., 1998
2. Natarajan M.K. "Principles of Fluid Mechanics", Agencies, Vidayal Karuppur, Kumbakonam, 1995.
3. Fox Robert W. and McDonald. Man T., Introduction Fluid Mechanics", John Wiley & Sons,1995.
4. www.nptelvideos.in/2012/11/fluid-mechanics.html
5. www3.eng.cam.ac.uk/~em257/LectNotes_all.pdf

Course Coordinator HOD

U18PECE015	**DESIGN OF HYDRAULIC STRUCTURES / IRRIGATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**

	Prerequisite: Introduction to Fluid Mechanics
	Course Coordinator Name & Department: Civil Engineering

COURSE OBJECTIVES: To present the basic theory and practice for various areas of Agricultural Engineering, application of engineering to the problems of agricultural production.To train the students and develop basic understanding of soil water plant relationship and select and design appropriate method of water application in varied situations.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To gain knowledge on soil water conservation, irrigation engineering and farm structures.	Ap
CO2	To understand the basic requirements of irrigation and various irrigation techniques, requirements of the crops.	U
CO3	To understand the basics of design of unlined and lined irrigation canals design.	U
CO4	To apply math, science, and technology in the field of water resource Engineering.	Ap
CO5	To design the Hydraulic structures.	C
CO6	To know about Participatory Irrigation Management	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	1	2		3			2		3	2		2	2
	CO2	1		2				3			1		1		
	CO3				2					2					2
	CO4	3	1	2		3			2		3	2		2	2
	CO5	1		2				3			1		1		
	CO6	3		2	3				3		3	2		3	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I IRRIGATION AS A SCIENCE 9

Definition, Need, Benefit, Historical Development, Scope in the country and the state - Sources for irrigation, wells, springs, rivers, streams, tanks, reservoirs - Flow and Lift irrigation. Methods of flow irrigation - Devices and equipments for lift irrigation - Duty, different concepts of duty and factors affecting duty.

UNIT II CROP WATER REQUIREMENTS 9

Soil – plant – water relationship - Evapotranspiration – consumptive use - Perennial, Annual and Seasonal crops - Principal irrigated, dry and wet irrigated crops - Assessment of crop water requirements - Effective rainfall - Net irrigation requirements for principal crops - Irrigational quality - Salt resistant crops - Water logging, remedial measures.

UNIT III CONVEYANCE &DISTRIBUTION OF IRRIGATION WATER 9

Head works – Diversion and storage structures -Canals unlined and lined. Canal alignments - contour ridge, Branch canals, minors, water course and notches - Control structures - drops, escapes, shutters and operating devices, division boxes - Cross drainage structures- undertunnels, aqueducts, siphons, siphon aqueducts - Cross masonry structures - road and railway bridges.

UNIT IVIRRIGATION WATER MANAGEMENT 9

Need for optimization of water use - Management and productivity - Minimizing irrigation water losses - Operational rules for regulation - physical structures for management on farm development works - Participatory Irrigation Management (PIM) - Water Users Associations (WUA) - Training the water users.

UNIT VDESIGN OF IRRIGATION STRUCTURES 9

Sluices and surplus weirs in tanks - Earthdam section, homogenous and zoned. Anicuts and weirs on solid and permeable foundation - Head regulators, canal drops, canal syphones and aqueducts, undertunnels - Simple design of masonry and earthdams- Designing channels- Computer aided designs.

TEXT BOOKS

1. Sharma R.K.Irrigation Engineering and Hydraulic Structures, Oxford and IBII Publishing Company, New Delhi, 2002.
2. Sathyanarayanan Murthy, Irrigation Design and Drawing, Published by Mrs.L.Banumathi, Tuni, East Godavari District. A.P. 1998.
3. S.K.Garg,Irrigation Engineering and Hydraulic structures,Khanna Publishers.2011.

REFERENCES

1. Michael A.M.Irrigation – Theroy and practice, Vikas Publishing House, 2000.
2. Hand Book on irrigation system operation Practices, Water Management and training Project Technical Report No.33. CWC, 1990.
3. Hand Book for improving Irrigation System maintenance Practices, Water Management and Training Report No.19A, CWC, Delhi, 1989.
4. www.nptel.ac.in/courses/105105110.

Course Coordinator **HOD**

U18PECE016	CONCRETE TECHNOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Building Materials & Testing Methods				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To impart knowledge to the students on the properties of materials for concrete by suitable tests, mix design for concrete and special concretes.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	To study about the various properties of concrete materials	U
CO2	To understand the behavior of fresh and hardened concrete	U
CO3	To identify the design concrete mixes as per IS and ACI codes	Ap
CO4	To understand the need for special concretes	U
CO5	To knowthe concept of concreting methods	U

CO6	To learn the special concreting methods.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	1	2		3			2		3	2		2	2
	CO2	1		2				3			1		1		
	CO3				2					2					2
	CO4	3	1	2		3			2		3	2		2	2
	CO5	1		2				3			1		1		
	CO6									3					3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I CONCRETE MAKING MATERIALS 9

Concrete; Properties of ingredients, tests, Grades of cement - Chemical composition, Hydration of cement - Production of concrete, mixing, compaction curing - Properties of fresh concrete

UNIT II CONCRETE 9

Properties of fresh concrete, Hardened concrete - Defects in Concrete, Concrete additivesBehavior of concrete in tension and compression, shear and bond - Influence of various factors on test results - Time dependent behavior of concrete - Creep, shrinkage and fatigue

UNIT III MIX DESIGN 9

Concrete mix design - Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion, different method of mix design. Quality control, Behavior of concrete in extreme environment

UNIT IV SPECIAL CONCRETE 9

Light Weight concrete, Fly ash concrete, Fibre reinforced concrete, Polymer Concrete, Super plasticized concrete, Epoxy resins and screeds for rehabilitation - Properties and Applications- High performance concrete.

UNIT V CONCRETING METHODS 9

Process of manufacturing of concrete, methods of transportation, placing and curing - Temperature problem in concreting, hot weather, cold weather and under water conditions, Resistance to freezing - special concreting method.

TEXTBOOKS:

1. Gupta.B.L., Amit Gupta, “Concrete Technology”, Jain Book Agency, 2010.
2. Shetty,M.S, “Concrete Technology”, S.Chand And Company Ltd, New Delhi, 2003

REFERENCES:

1. Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007
2. Neville, A.M; "Properties Of Concrete", Pitman Publishing Limited, London,2010
3. Gambir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007
4. IS10262-2009 Recommended Guidelines For Concrete Mix Design, Bureau Of Indian Standards, New Delhi.
5. https://nptel.ac.in/courses/105102012/
6. https://nptel.ac.in/courses/105102012/#

Course Coordinator **HOD**

U18PECE017	**ADVANCED SOIL MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Geotechnical Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To understand stability and failure mechanisms of substructure. To design the suitable foundation in the problematic soils with necessary instruments.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To understand slope stability and failure mechanisms	U
CO2	To solve problems related to earth pressures	E
CO3	To solve practical problems related to stability of retaining walls	E
CO4	To design the pile foundation in problematic soils	C
CO5	To determine the soil structure interaction by using modern instruments	E
CO6	To learn the pore pressure measurements.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	1		2				3			1		1	3	
	CO2				2					2					2
	CO3	3	1	2		3			2		3	2		2	2
	CO4	3					3			2			3		3
	CO5		2								1			2	
	CO6	2	3		2		3			2		2			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I SLOPE STABILITY 9

Slope failure mechanisms - Types - Infinite slopes - Finite slopes - Total stress analysis for saturated clay - Method of slices - friction circle method - Use of stability number - Slope protection measures.

UNIT II EARTH PRESSURES 9

Earth pressure theory – Plastic equilibrium in soils – active and passive states – Rankine's theory – Coloumb's wedge theory – Classical and limit equilibrium solution – Earth pressure on retaining walls of simple configurations – pressure on the wall due to single line load alone.

UNIT III ANALYSIS OF RETAINING WALLS 9

Types of retaining walls- Analysis of retaining walls- Graphical method - Culmann's method – Rehbhan's method- Stability of retaining wall.

UNIT IV PILE FOUNDATION 9

Types of piles – Factors influencing the selection of pile – cuts and excavations - Sheet Piles – Codal provisions

UNIT V INSTRUMENTATION 9

Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells,earth pressure cells, settlement and heave gauges, pore pressure measurements – slopeindicators, sensing units, case studies.

TEXT BOOKS:

1. Punmia, B.C., Soil mechanics and foundations, Laxmi publications pvt. Ltd., New Delhi.

REFERENCES:

1. Khan, I.H., A text book of Geotechnical Engineering, Prentice Hall of India, New Delhi, 1999.
2. Arora K.R. Soil mechanics and foundation engineering, standard publishers and distributors, New Delhi, 1997.
3. Bowles J.E. Foundation analysis and design, McGraw Hill, 1994.
4. Gopal Ranjan and Rao, A.S.R. Basic and applied soil mechanics, Wiley Eastern Ltd., New Delhi (India), 1997.
5. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-361-advanced-soil-mechanics-fall-2004/lecture-notes/
6. http://www.nptelvideos.in/2012/11/soil-mechanics.html

Course Coordinator **HOD**

U18PECE018	**GEOMETRIC DESIGN OF HIGHWAYS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Surveying & Geomatics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: The students can apply the Interpretation of geometric design fundamentals in the field. To learn about IRC standards and guidelines for design problems. Also design of intersections and drainage facilities are very important applications of this course.

COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**

CO1	To know the design provision as per IRC guidelines.	U
CO2	To know the design principles of grade intersections.	U
CO3	To know the design principles of grade interchanges.	An
CO4	To learn the concepts of non motorized traffic zones.	An
CO5	To learn the geometric design of air fields.	An
CO6	To understand the Right of way and width considerations for roadway, shoulders, kerbs traffic barriers, medians, frontage roads.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	1	2		3			2		3	2		2	2
	CO2	1		2				3			1		1		
	CO3									3					3
	CO4	1		2				3			1		1	3	
	CO5				2					2					2
	CO6	3	1	2		3			2		3	2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 INTRODUCTION 9

Introduction - Classification of rural highways and urbanroads. Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors.

UNIT II DESIGN OF AT GRADE INTERSECTIONS & INTERCHANGES 9

Design Of Intersections: Characteristics and design considerations of at-grade intersections; Rotary intersections; - Design of Parking lots - Principles of design, channelization, roundabouts, staggered intersections, Grade separations and interchanges: Design of interchanges - Major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes

UNIT III GEOMETRIC DESIGN 9

Geometric design provision for various transportation facilities as per IRC guidelines, geometric design of horizontal and vertical alignment, design of expressways/ high speed corridors - Facilities for non motorized traffic - Bicycles and pedestrian facility design, slow carriagewaysbuses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

UNIT IV DESIGN COMPONENTS 9

Design Elements: Sight distances, Horizontal alignment - design considerations, stability at

curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads.

UNIT V DESIGN OF DRAINAGE FACILITIES 9

Design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems; Importance,Principle, drainage of various geometric elements, surface and subsurface drainage.

TEXTBOOKS:

1. Keith M. Wolhuter, "Geometric Design of Handbook" by CRC press, 2017.
2. Mannering Fred L., Kilarski Walter P. and Washburn Scott S., "Principles of Traffic Engineering and Traffic Analysis", Third Edition, Wiley 2007
3. Kadyali L.R. and Lal N.B., "Principles and Practices of Highway Engineering", Khanna Publishers 2006.
4. O'Flaherty, A. Coleman, "Highways: the Location, Design, Construction and Maintenance of Road Pavements", 4thEd. , Elsevier 2006.

REFERENCES:

1. Daniel .J Findley "highway engineering planning design" Butterworth-Heinemann; First Edition 2015.
2. Roess, R. P., Prassas, E. S., and McShane, W. R., "Traffic Engineering, 4th Edition, Prentice Hall, 2010.
3. Chakroborty Partha and Animesh Das, "Principles of Transportation Engineering", Prentice hall, 2005
4. Salter. R.I and Hounsell N.B, " Highway Traffic Analysis and design", Macmillan Press Ltd.1996.
5. www.civil.iitb.ac.in/tvm/nptel/301_IntroGD/web/
6. libvolume3.xyz/civil/btech/semester7/highwaygeometric

Course Coordinator HOD

PROFESSIONAL ELECTIVE - II (PE –II)

U18PECE021	**URBAN TRANSPORTATION & PLANNING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Surveying & Geomatics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To give an overview of Traffic engineering, traffic regulation, management and traffic safety with integrated approach in traffic planning as well. To learn about growth factor models, gravity models and opportunity modes.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Analyze National policies and strategies on issues related to Urban development	An
CO2	To learn about different types of plan, formulation and evaluation.	U
CO3	To understand the concepts of plan implementation and urban management.	U
CO4	To learn about sustainable urban and transport principles.	U
CO5	To analyze the future Scenarios and shape of Urban Region.	An
CO6	To understand the Economic Benefits of Sustainable Transportation .	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1									3					3
	CO2	1		2				3			1		1	3	
	CO3				2					2					2
	CO4	3	1	2		3			2		3	2		2	2
	CO5	1		2				3			1		1		
	CO6				2					2					2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I URBAN PLANNING AND DEVELOPMENT 9

Introduction-Definition of terms, Explanation of concepts, National policies and strategies on issues related to Urban development – Trends of Urbanization- Positive and Negative impacts of Urban development Principles of planning – Types and levels of Urban plans, Stages in the planning process.

UNIT II DEVELOPMENT PLANS, FORMULATION & EVALUATION 9

Scope and content of Regional Plan, Master Plan, Detailed Development Plan, Structure Plan, Sub Regional Plan, DCR planning and developments of industrial estates, SEZ, Development strategies, formulation and evaluation.

UNIT III PLAN IMPLEMENTATION AND URBAN MANAGEMENT 9

Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Decision Support System for Urban Management – Involvement of public, private, NGO, CBO & Beneficiaries.

UNIT IV SUSTAINABLE URBAN AND TRANSPORT PRINCIPLES 9

Urban Environmental Sustainability, Urban Sustainable Development, Methods and Tools for Sustainable Appraisal, Sustainable Transportation – Principles, indicators and its implications Environment and Resources- Economic Benefits of Sustainable Transportation.

UNIT V URBAN REGION AND ENVIRONMENT 9

Sustainability Assessment, Future Scenarios, Shape of Urban Region, Managing the change, Integrated Planning, Sustainable Development- City Centre, Development Areas, Inner City Areas, Suburban Areas, Periurban and Country side, Economy and Society.

TEXTBOOKS:

1. Pratap Rao .M " Urban planning theory and practice'' publisher CBS 2012.
2. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 201.
3. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010.
4. Goel .S.L Urban, "Development and Management", Deep and Deep publications, New Delhi,2002.
5. Michael D. Meyer and Eric J.Miller, "Urban Transportation Planning" McGraw Hill Publications, Second edition, 2000.

REFERENCES:

1. CMDA,"Second Master Plan for Chennai", Chennai 2008.
2. Sustainable Transportation and TDM – Planning the balances, "Economic, Social and Ecological objectives"; Victoria Transport Policy Institute, 2007.
3. Singh .V.B, "Revitalized Urban Administration in India", Kalpaz publication, Delhi 2001.
4. Joe Ravetz, "City Region 2020 – Integrated Planning for a Sustainable Environment", 2000.
5. https://nptel.ac.in/courses/105107067/
6. http://www.nptelvideos.in/2012/11/urban-transportation-planning.html
7. https://www.academia.edu/15029943/NPTEL_Introduction_to_Transportation_Planning
8. http://vssut.ac.in/doc/Transportation-1_Lecture-Note.pdf

Course Coordinator **HOD**

U18PECE022	CONSTRUCTION COST ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To study the concepts of Construction Economics and Finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, and management of accounting.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about basic principles like Time Value of Money, Cash Flow diagram, Nominal and effective interest	U
CO2	To know about the Comparing alternatives such as Present Worth Analysis, Annual Worth Analysis etc;	U
CO3	To understandthe concept of evaluating alternative investments.	U
CO4	To understand the methods of Project Finance and Working Capital Management.	U
CO5	To understand the basics of Management accounting and Financial accounting principles.	U
CO6	To get knowledge on International financial management foreign currency management.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2		3			2			3		2	1	3
	CO2	3		2						3		3			3
	CO3	1		2		3		3	2		1		1	3	
	CO4		2		2		2			2					2
	CO5							2			3	2			
	CO6	3			3						3			3	1

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BASIC PRINCIPLES 9

Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest . Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient(G), Geometric Gradient (C).

UNIT II COMPARING ALTERNATIVES PROPOSALS 9

Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis,

Benefit/Cost Analysis, Break Even Analysis.

UNIT III EVALUATING ALTERNATIVE INVESTMENTS 9

Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.

UNIT IV FUNDS MANAGEMENT 9

Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management foreign currency management.

UNIT V FUNDAMENTALS OF MANAGEMENT ACCOUNTING 9

Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.

TEXT BOOKS:

1. Blank, L.T., and Tarquin,a.J (2012) Engineering Economy,7th Edn. Mc-Graw Hill Book Co.
2. Collier C and GlaGola C (1998) Engineering Economics & Cost Analysis, 3nd Edn. Addison Wesley Education Publishers.
3. Patel, B M (2007) Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi.

REFERENCES:

1. Shrivastava,U.K., (2000)Construction Planning and Management,2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi.
2. Steiner, H.M. (1996) Engineering Economic principles, 2nd Edn. Mc-Graw Hill Book, New York.
3. http://fmcet.in/CIVIL/CE6704_uw.pdf
4. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104161/lec1.pdf
5. https://nptel.ac.in/courses/105103023/#
6. https://www.cmu.edu/cee/projects/PMbook/12_Cost_Control,_Monitoring,_and_Accounting.html

Course Coordinator **HOD**

U18PECE023	**TRANSPORT OF WATER AND WASTE WATER**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Fluid Mechanics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain, with emphasis on computer application.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals design for external loads, maintenance and operation. Sanitary Sewerage Systems.	U
CO2	To understand about the populationforecasting Design period - Variation in demand - Factors Affecting per capita consumption.	U
CO3	To understand in detail Water transmission main design methods for analysis and optimization Laying and maintenance.	U

CO4	To improve the knowledge of Flow estimation, and sewer design, conventional and model based design, sewage pumps.	Ap
CO5	To know about the Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains.	An
CO6	To get knowledge on conventional and model based design pumps.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2		2		2			2			2		2
	CO2							2			3	2			
	CO3	3			3						3			3	1
	CO4	3		2						3		3			3
	CO5	1		2		3		3	2		1		1	3	
	CO6		2		2		2			2					2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I WATER SUPPLY SYSTEMS 9

Storage requirements, impounding reservoirs, intake structures, pipe, hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation. Sanitary Sewerage Systems:

UNITII POPULATIONFORECASTING 9

Forecasting of population - Arithmatic Increase - Geometrical Increase - Incremental Increase - Graphical Methods - Logistic Curve Method - Per capita consumption - Design period - Variation in demand - Factors Affecting per capita consumption.

UNIT IIIDISTRIBUTION 9

Water transmission main design - pipe materials - economics - water distribution pipe networks - methods for analysis and optimization - Laying and maintenance, insitu lining - appurtenances.

UNIT IV - SANITARYSEWERAGE SYSTEMS 9

Flow estimation, sewer materials, hydraulics of flow in sewers, sewer layout, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.

UNIT V STORM WATER 9

Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance

TEXT BOOKS:

1. Joanne E. Drinan (Author), Water and Wastewater Treatment ,July , 2012
2. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.
3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2003.

REFERENCES

1. Hammer.M.J. "Water and Wastewater Technology",Regents/ Prentice Hall, New Jercy2001.
2. Rakesh Kumar and R N Singh "Municipal Water and Waste Water Treatment"2012
3. Sonthosh kumar Garg "Water Supply Engineering"2/khana publications 2010 edition
4. https://easyengineering.net/waste-water-engineering-books/
5. https://nptel.ac.in/courses/105104102/
6. https://www.researchgate.net/publication/221911472_Wastewater_Management
7. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-85-water-and wastewater-treatment-engineering-spring-2006/lecture-notes/

Course Coordinator **HOD**

U18PECE024	OPEN CHANNEL FLOW	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Hydraulics Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: Application of principles of fluid mechanics to the solution of problems encountered in both natural and constructed water systems. Use of model studies and computers in solving a host of problems in hydraulic engineering.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	The students will be apply their knowledge about fluid mechanics in addressing problems in open channels	Ap
CO2	They will develop skills to solve problems using software.	An
CO3	They will be able to make flow measurements in fields.	C
CO4	To design channels for sediment transport	C
CO5	To design hydraulic models	C
CO6	To learn the design concepts of stable channels and regime channels.	C

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	2		3					2		2		3	
	CO2			2			2				1				2
	CO3	3								3			2	2	
	CO4		2		3			2			2				
	CO5	3		2						3		3		1	3
	CO6	1		2		3		3	2		1		1	3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BASIC PRINCIPLES 9

Basic concepts of uniform flow - computations. Specific energy and specific force concepts – applications.

UNIT II STEADY VARIED FLOWS IN OPEN CHANNELS 9

Dynamic equation for spatially varied flows. Flow profile computations. Introduction to HEC-RAS. Spatially varied flows and rapidly varied flows – applications.

UNIT III UNSTEADY FLOWS IN OPEN CHANNELS 9

Equations of motion. Uniformly progressive wave. Rapidly varied unsteady flow – positive and negative surges. Dam break problem. Flood routing in large channel networks, Flood routing in compound channels; Flood routing in channels with flood plains, Surface irrigation flow modeling

UNIT IV SEDIMENT TRANSPORT 9

Sediment properties – inception of sediment motion – bed forms. Bed load suspended load – Total sediment transport. Design of stable channels and regime channels. Reservoir sedimentation and trap efficiency.

UNIT V FLOW MEASUREMENTS AND HYDRAULIC MODELING 9

Sharp-Crested weirs, broad-crested weirs, critical depth flumes. Recent advancement in open channel flow measurements. Physical modeling in hydraulics. Dimensional analysis. Modeling closed flows and free surface flows. Distorted models. Design of physical models.

TEXT BOOKS

1. Sturm T.W., Open Channel Hydraulics – Tata-McGraw Hill 2 nd edition, New Delhi 2011. ISBN:978-1-25-900225-0
2. Wurbs R.A., and James W.P. Water Resources Engineering. Prentice Hall of India, Eastern Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007.
3. Subramanya K., Flow in Open Channels (2nd ed.) Tata McGraw Hill, ISBN 00-746- 2446-6, New Delhi 2003.

REFERENCES

1. Chaudhry M. H., Open Channel Flow. Prentice Hall of India, Eastern Economic Edition, ISBN: 81-203-0863-8, New Delhi. 1994.
2. Chow Ven-te Open Channel Hydraulics McGraw Hill, New York NY 1959.
3. French, R. H., Open Channel Hydraulics McGraw Hill, New York NY 1985.
4. Srivastava R. Flow through Open Channels Oxford University Press New Delhi
5. https://easyengineering.net/open-channel-flow-made-easy/

6.http://web.iku.edu.tr/~asenturk/Microsoft%20PowerPoint%20-%20open-channel%201.pdf7.

7. https://lecturenotes.in/u/saurabh25

8.https://www.engineeringonyourfingertips.ooo/2019/09/pdf-strength-of-materials-books-collection-free-download.html

Course Coordinator HOD

U18PECE025	GROUNDWATER ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Foundation Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: The objective of this course is enable to the student to understand the basic empirical knowledge of the residence and movement of groundwater, as well as a number of quantitative aspects.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Able to evaluate the aquifer parameters and groundwater resources for different hydro-geological boundary conditions	E
CO2	Formulate and solve conjunctive use of surface water and groundwater resource utilization problems	An
CO3	Identify sites for artificial recharge of groundwater	An
CO4	To imparts exposure towards well design and practical problems of ground water aquifers.	An
CO5	To study about groundwater quality and contamination	U
CO6	To understand the Evaluation of well loss parameters.	E

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2			3			2			3		1	2	3
	CO2		3												
	CO3						1	2		1	3	2			2
	CO4	3			3						3			3	1
	CO5	3	3	2			3			3		3			3
	CO6	1		2		3		3	2		1		1	3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I GROUNDWATERBASICS 8

Introduction to Groundwater – Hydro meteorology – Groundwater in Hydrologic Cycle – Occurrence of groundwater – zone of Aeration and Saturation – Hydrogeology — Types of aquifers soil sample analysis - Water bearing materials – Aquifer parameters and its determination.

UNIT II GROUNDWATER HYDRAULICS 10

Groundwater Movement - Darcy's law and its limitations - Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of

wells – Interference of wells

UNIT III PUMPING TEST ANALYSIS 10

Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells.

UNIT IV WELL DESIGN AND CONSTRUCTION 8

Well design criteria – Construction of wells – Well drilling methods – Filter design – Artificial and natural packing – Well casings and screens – Production test – Maintenance of production wells – Pumping Equipment – protection of wells and Rehabilitation – Horizontal wells - Collector wells and Infiltration galleries

UNIT V SPECIAL TOPICS 9

Methods of artificial groundwater recharge – Groundwater Basin Management and conjunctive use - Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence – Groundwater flow in Hard Rock System: conceptual models – structure and hydrodynamic properties of hard rock aquifers.

TEXT BOOKS

1. Todd D.K., Groundwater Hydrology, John Wiley & Sons, Inc, New York, 2011
2. Bear J., Hydraulics of Groundwater, McGraw-Hill, New York, 2007
3. Bouwer H., Groundwater Hydrology, McGraw-Hill, New York, 2013.

REFERENCES:

1. Driscoll, Groundwater and Wells, Johnson Filtration Systems, Inc., 2014
2. Hantush M.S., Hydraulics of wells in Advances in Hydro science, Academic Press, 1964.
3. Ojha, C.S.P, Berndtsson, R and Bhunya, P., Engineering Hydrology, Oxford University Press,New Delhi, 2008.
4. Rastogi A.K. , Numerical Groundwater Hydrology, 2011
5.https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-72-groundwater-hydrology-fall-2005/lecture-notes/
6. https://nptel.ac.in/courses/105105042/
7. https://nptel.ac.in/courses/105105106/
8. https://mvsrcivil1.blogspot.com/2016/02/groundwater-hydrology-text-books-notes.html
9.http://www.riversimulator.org/Resources/farcountry/Hydrogeology/GroundwaterHydraulicsLohman1972pp708.pdf

Course Coordinator HOD

U18PECE026	**DESIGN OF CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Reinforced Concrete Design				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To impart concepts of design of reinforced concrete structures such as, retaining walls water tanks, components of bridge.To make the students know the concepts of design of structures like prestressed concrete continuous beams.

COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**

CO1	To design the reinforced concrete elements using limit state and working stress methods	C
CO2	To study about the design of types of reinforced concrete slab using limit state method	C
CO3	To understand the design concept of shear, bond, anchorage and torsion.	U
CO4	To know the limit state design of reinforced concrete column	An
CO5	To know he limit state design of reinforced concrete footing	An
CO6	To learn the detailing for earthquake resistant construction.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		3		3				2		3		2		2
	CO2	3					1	2		1	3	2		2	2
	CO3			2			2				1				2
	CO4	3				1				3			2	2	
	CO5		2		3			2			2				1
	CO6	3		2						3		3		1	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I RETAINING WALLS 9

Design of cantilever and counter-fort type retaining wall - All design steps/process to as per the most recent BIS code of practices

UNIT II WATER TANKS 9

Water tank and staging - Introduction, Design criteria - Design of rectangular and circular water tank - Design of Intze tank - Staging for overhead tank

UNIT III BRIDGES 9

Introduction to bridge engineering - Investigation for bridges, IRC loadings - Design of slab culvert

UNIT IV PRE STRESSED CONCRETE 9

Design of end block - Pre-stressed concrete - Introduction,Principles of Pre–stressing pre-stressing system - losses in pre-stress

UNIT V DESIGN OF BEAMS AND FRAMES 9

Design of continuous beams and building frames -Moment redistribution, Estimation of wind and seismic loads - Desirable features of earthquake resistant construction -Detailing for earthquake resistant construction.

Text Books:

1. Krishnaraju, N. 'Reinforced Concrete Design', CBS Publishers and Distributors, Delhi. 2016
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi. 2002.
3. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi 2007.

REFERENCES:

1. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2010.
2. Lin T.Y. & Ned H.Burns,"Design of prestressed concrete structures",Wiley IndiaPrivate Limited,2010.
3. Punmia B.C.,Jain A.k.,Jain A.K.,"RCC Designs", Laxmi Pub.(P) Ltd.,2003.
4. IS 1343 – 2012Code of Practice for Prestressed Concreteby Bureau of Indian Standards.
5. IS 456-2000: Plain and Reinforced Concrete – Code of Practice by Bureau of Indian Standards.
6. https://nptel.ac.in/courses/105105105/
7. http://www.nptelvideos.com/video.php?id=1646&c=11
8. http://www.nptelvideos.in/2012/11/design-of-reinforced-concrete-structures.html
9. https://lecturenotes.in/subject/167/design-of-concrete-structures-dcs
10. https://easyengineering.net/design-of-reinforced-concrete-structures-by-subramanian/
11. https://drive.google.com/file/d/1H-x7BRsjRKPz5Wv2o8s9RQdTscSMr7Gr/view

Course Coordinator **HOD**

U18PECE027	**GROUND IMPROVEMENT TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Geotechnical Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To develop an understanding of the ground improvement techniques and use of new materials and its behaviour for ground improvement techniques.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To develop an awareness of problematic soils and selection of ground improvement techniques based on soil conditions	U
CO2	To understand drainage, dewatering, grouting technique in ground improvement method	U
CO3	To understand the in situ densification of cohesion less and cohesive soils	U
CO4	To understand the applications of grouting and its materials	U
CO5	To get the awareness of the ground improvement techniques and to study the applications of geosynthetics.	An
CO6	To learn the procedures for piles-installation techniques.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3						3			3	1
	CO2	3	3	2			3			3		3			3
	CO3	1		2		3		3	2		1		1	3	

	CO4			2			2				1				2
	CO5	3				1				3		1	2	2	
	CO6		2		3			2			2				1

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I GEOTECHNICAL PROBLEMS **9**

Ground improvement - Role of ground improvement infoundation engineering, Methods of ground improvement, Geotechnicalproblems in alluvial, lateritic and black cotton soils, Selection of suitable ground improvement techniquesbased on soil conditions

UNIT II DEWATEREING **9**

Dewatering Techniques - Well points, Vacuum and electro-osmotic methods, Seepage analysis for two dimensional flow - fully andpartially penetrated slots in homogeneous deposits (Simple cases only)

UNIT III METHODS OF GROUND IMPROVEMENT **9**

In-situ densification of cohesion-less soils andconsolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compactionpiles. Consolidation: Preloading with sand drains, and fabric drains, Stone columns, Lime piles-installation techniques only – relative meritsand limitations – deep soil mixing

UNIT IV GROUTING TECHNIQUE **9**

Grouting - Types of grouts – Suspension grouts - solutions grouts, Grouting equipment and method - Grouting with soil, Bentonite - cement mixes and asphalt – Grout monitoring schemes

UNIT V GEOSYNTHETICS APPLICATIONS **9**

Geosynthetics - Functions of Geotextiles – Separation – Filtration – Drainage - reinforcement - Geomembranes - Containments and barriers - Application to Ground Anchors.

TEXT BOOKS

1. Purushothama Raj. P, “Ground Improvement Techniques”, Laxmi Publications (P) Ltd. New Delhi, 2000.

REFERENCE BOOKS

1. Koerner. R. M, “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, new York, 1984.
2. Moseley. M.P, “Ground Improvement”, Blockie Academic and Professional, Chapman and Hall, Glassgow, 1998.
3. Winterkorn .H .F and Fang. H. Y, “Foundation Engineering Hand Book”, Van Nostrand Reinhold, 1994.
4. Koerner. R. M, “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, New Jersey, 1999.
5. IS: 13094:1992- “Selection of ground improvement techniques for foundations in weak

soils", BIS, New Delhi, 1992
6. Jie Han, "Principles and Practice of Ground Improvement", John Wiley & Sons, Inc. 2015
7.https://lecturenotes.in/subject/228/ground-improvement-techniques-git
8.https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_GIT_NOTES_0.pdf
9. https://nptel.ac.in/courses/105108075/

Course Coordinator **HOD**

U18PECE028	PUBLIC TRANSPORTATION SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Surveying & Geomatics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: Student gains knowledge on various parts of public transport characteristics and the design considerations. Also get familiar with transit scheduling, components of scheduling Process, determination of service requirements.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understand the importance of public transport activities.	U
CO2	To know about the transport travel characteristics.	U
CO3	To understand the concepts of trip.	U
CO4	To learn the ideas of transit network and scheduling	Ap
CO5	To know about transit system statistics	U
CO6	To understand the principles of good layout.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3						3			3	1
	CO2	3	3	2			3			3		3			3
	CO3	1		2		3		3	2		1		1	3	
	CO4	3			3						3			3	1
	CO5	3	3	2			3			3		3			3
	CO6	1		2		3		3	2		1		1	3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 INTRODUCTION **9**

Public Transport and Socioeconomic Activities, Historical Development of Transport, Transportation in the Cities, Freight Transportation, Future Developments, Urban Transportation System Planning - Conceptual Aspects - Transport Planning Process, Sequence

of Activities Involved in Transport analysis.

UNIT II TRANSPORT TRAVEL CHARACTERISTICS 9

Transport travel characteristics – Trip chaining, technology of bus, rail, rapid transit systems, basic operating elements, Trip Generation Analysis - Trip Production Analysis, Category Analysis, Trip Attraction Modelling. Trip Distribution Analysis - Presentation of Trip-Distribution Data, Basis of Trip Distribution, Gravity Model of Trip Distribution, Methods of Trip Distribution.

UNIT III TRANSIT NETWORK 9

Transit network planning – planning, objectives, principles, considerations, transit lines – types, geometry, transit routes and characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations.

UNIT IV TRANSIT SCHEDULING 9

Components of scheduling process - determination of service requirements, scheduling procedure, marginal ridership, crew scheduling, transit agency and economics, organizational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure.

UNIT V DESIGN CONSIDERATIONS 9

Design of facilities – bus stops and terminals – principles of good layout, types of layout, depot location, twin depot concept, crew facilities and amenities.

TEXTBOOK:

1. Ashish verma.T.V, Ramanayya, "Public transport planning and management in developing countries", CRB press New York 2015.
2. Papacostas, C.S., and Prevedouros, P.D. "Transportation Engineering and Planning", Prentice - Hall of India Pvt Ltd., 3rd Edition, 2002,
3. Ponnuswamy .S, David Johnson victor, "Urban transportation planning operation and management "McGraw Hill Education (Indian) private limited, New Delhi.
4. John W.Dickey. (1975). Metropolitan Transportation Planning. McGraw Hill Book Company, New York.

REFERENCES:

1. Wright P.H. "Highway Engineers", John Wiley and Sons, Inc., New York, 2013.
2. Adib Kanafani (1983). Transportation Demand Analysis. McGraw Hill Series in Transportation, Berkeley.
3. Hutchinson, B.G. (1974). Principles of Urban Transport Systems Planning. McGraw Hill Book Company, New York.
4. John W.Dickey. (1975). Metropolitan Transportation Planning. McGraw Hill Book Company, New York.
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105106058/lec5.pdf
6. https://nptel.ac.in/courses/105107123/
7. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-1.pdf
8. https://pdfs.semanticscholar.org/be85/7421541858ae7f927067b2f7765f2b39522a.pdf
9. https://www.slideshare.net/EddyAnkitGangani/urban-transportation-system-mass-transit-system

Course Coordinator HOD

PROFESSIONAL ELECTIVE - III (PE – III)

U18PECE031	REMOTE SENSING AND GIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Surveying & Geomatics				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To introduce the students to the basic concepts and principles of various components of remote sensing. To provide an exposure to GIS and its practical applications in civil engineering.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study the basic concepts of Remote Sensing.	U
CO2	To know about the how the EMR interactions with water, atmosphere and earth surface materials.	U
CO3	To study and apply various image interpretation, enhancement and classification techniques.	Ap
CO4	To acquire knowledge about History, development of GIS and concept of Data Entry, Storage & Maintenance of the DBMS in GIS.	Ap
CO5	To Apply Remote Sensing and GIS in applications in land use, disaster management, and resource information systems.	Ap
CO6	To understand the various components of GIS.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			2			1			3		2		3
	CO2	1		2		3		3	2		1		1	3	
	CO3	3			3						3			3	1
	CO4	3	3	2			3			3		3			3
	CO5										2			2	
	CO6	2			3			3				2			2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I REMOTE SENSING 9

Definition Historical Components of Remote Sensing Principles & methods of remote sensing - Active and Passive remote sensing - Remote Sensing platforms -Electromagnetic radiation- Spectrum- Block body radiation – Planks law – Stefan – Boltzmann law – satellites

classification – based on orbit- sun synchronous and Geosynchronous based on purpose Earth Resources satellites, communication satellite Weather satellites Spy satellites Sensors Description of sensor in landscape, spot, IRS series and current satellites- Radar-SLAR and SAR.

UNIT II EMR INTERACTIONS 9

EMR Interaction with atmosphere- Scattering -Rayleigh, Mie, Non Selective and Raman Scattering, Back scattering- EMR Interaction with water and Ozone- Atmospheric windows and its significance -EMR interaction with the earth surface materials- Radiance, irradiance, Absorbed and Transmitting energy – Reflectance - Specular and diffuse surface, Spectral signature and curves, EMR interaction with soil- Resolution- Spectral, Spatial, Radiometric, and Temporal.

UNIT III DIGITAL IMAGE PROCESSING 9

Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys - Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification – Supervised and Unsupervised Classification-DEM- Types, Sources of digital Elevation data-Shuttle Radar Topographic Mission (SRTM) data.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 9

GIS – Components of GIS – Hardware, Software and Organisational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters.

UNIT V REMOTE SENSING AND GIS APPLICATIONS 9

Integration of GIS and Remote Sensing – Applications - Urban Applications-– Water resources – Watershed Management – Rainfall-Runoff Modeling- Flood Mapping-Resources Information Systems and other applications.

TEXT BOOKS:

1. Anji Reddy, “Remote Sensing and Geographical Information Systems” , BS Publications 2001

REFERENCES:

1. Anand P.H,”Principles of remote Sensing and Geographical Information Systems”, Sri Venkateswara Publishers, 2003.
2. Lillesand T.M and Kiefer R.W. Remote sensing and Image, Interpretation, John Wiley and Sons, INC, New York, 1987.
3. Burrough P A,”Principle of GIS for land resource assessment”, Oxford University, 1990.
4. https://nptel.ac.in/courses/105108077/
5. https://nptel.ac.in/courses/105103193/

Course Coordinator HOD

U18PECE032	CONSTRUCTION PRODUCTIVITY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

	Prerequisite: Construction Technology
	Course Coordinator Name & Department: Civil Engineering

COURSE OBJECTIVES: To understand the factors that impact construction productivity, the use of management tools to develop construction productivity improvement programs.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about the role of productivity in the construction.	U
CO2	To know Tools to measure productivity in Construction.	U
CO3	To learn the Productivity analysis from Daily Progress Reports.	An
CO4	To learn Techniques for Measuring and Improving Productivity at Construction Sites.	An
CO5	To understand theProductivity improvement measures.	U
CO6	To understand Techniques for Measuring and Improving Productivity at Construction Sites.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3						3			3	1
	CO2	3	3	2			3			3		3			3
	CO3	1		2		3		3	2		1		1	3	
	CO4	1		2		3		3	2		1		1	3	
	CO5	3			3						3			3	1
	CO6	1		2		3		3	2		1		1	3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Definition of Productivity, Impact of productivities on construction duration and costs, Factors Impacting Construction Productivity, role of productivity in the construction. Constructability and Off-site Construction.

UNIT II PRODUCTIVITY IN CONSTRUCTION 9

Tools to measure productivity in Construction, variousmeasuring productivities of construction equipment, Staff and Labour and typical benchmarks for the same, method of measuring the construction productivity, Factors Affecting Labor Productivity.

UNIT III PRODUCTIVITY ANALYSIS 9

Productivity analysis from Daily Progress Reports; what is Productivity?, Lean Construction concepts of Value Adding activities, Non-Value Adding Activities and Non-Value Adding but Necessary Activities;

UNIT IV FRAMEWORK AND MEASUREMENT 9

Framework for Productivity Improvement in Construction, Productivity measurements by special Lean Construction-oriented field methods such as Work Sampling, Techniques for Measuring and Improving Productivity at Construction Sites, Takt time analysis, Foreman Delay Surveys;

UNIT V PRODUCTIVITY MANAGEMENT 9

Productivity improvement measures such as Value Stream Mapping, Location-Based management Systems, 5S, good Housekeeping, etc.; use of specialist software such as Vico for productivity studies.

TEXT BOOKS:

1. Construction Productivity:Measurement and Improvement,James J. Adrian, Champaign, IL, Stipes Publishing, L.L.C., 2004.
2. Baldwin, A. & Bordoli, D., A Handbook for Construction Planning and Scheduling, Blakwell Publishers, 2014.
3. Productivity Improvement in Construction, Oglesby, C., parker, H., and Howell, G. New York: McGraw Hill, 1989.

REFERENCES:

1. Construction Productivity- A Practical Guide for Building and Electrical Contractors, Ed: Eddy M. Rojas, J. Ross Publishing, 2008.
2. Knutson, K., Schexnayder, C. J., Fiori, C. & Mayo, R.E., Construction Management Fundamentals, MCGraw Hill Publishers, 2013.
3. https://nptel.ac.in/courses/105102088/
4. https://nptel.ac.in/courses/105106149/

Course Coordinator **HOD**

U18PECE033	BIOLOGICAL PROCESS FOR CONTAMINANT REMOVAL	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To educate the students on principles and design of various biological treatment units used for wastewater treatment. To study about the treatment of Aerobic and anaerobic process.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Basics of microbiology, metabolism and energetic, bio kinetic parameter, reactors and reactor analyses	R
CO2	Aerobic treatment of wastewater and Process of design considerations.	C
CO3	understand in detail about Anaerobic Treatment of Wastewater	U
CO4	Improvement in the design of sludge	C
CO5	Know the Operations, Maintenance, Management and Case Studies	U
CO6	To carry out case studies on sewage treatment plants.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

2	CO1	1		2		3		3	2		1		1	3	
	CO2	3			3						3			3	1
	CO3	3	2		2			1		2	3		2		3
	CO4			2		3		3	2		1		1	3	
	CO5	3			3						3	1		3	1
	CO6		3	2			3			3		3			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT-I INTRODUCTION 9

Understanding of basics of microbiology, metabolism and energetic, bio kinetic parameter, reactors and reactor analyses. Characterization of waste. Aerobic, anaerobic and anoxic systems. Suspended and attached growth biological systems.

UNIT-II AEROBIC TREATMENT OF WASTEWATER 9

Activated Sludge processand process modifications, Process design considerations, Treatment Ponds and aerated Lagoons, aerobic pond, facultative pond, anaerobic ponds, polishing ponds, constructed wet lands etc. Attached Growth Biological Treatment Systems, Trickling Filters, Rotating Biological Contactors. Activated Biofilters, Moving bed biological reactor (MBBR), Sequential Batch reactors (SBR), Membrane Biological Reactors (MBR)

UNIT-III ANAEROBIC TREATMENT OF WASTEWATER 9

Anaerobic processes, Process fundamentals, Standard, high rate and hybrid reactors, Anaerobic filters, Expanded /fluidized bed reactors, Upflow anaerobic sludge blanket reactors, Performance and design aspects, Expanded granular bed reactors, Two stage/phase anaerobic reactors. Sludge Digestion, anaerobic digestion, aerobic digestion

UNIT-IV SLUDGE TREATMENT AND DISPOSAL 9

Design of sludge management facilities, slude thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity)- upgrading existing plants-ultimate residue disposal- recent advances.

UNIT-V OPERATIONS,MAINTENANCE, MANAGEMENT AND CASE STUDIES 9

Operational problems-trouble shooting, planning, organizing and controlling of plants operations- capacity building, case studies on sewage treatment plants- sludge management facilities.

TEXT BOOKS:

1. Arecivala, S.J., Wastewater treatment for pollution control, TMH, New Delhi 2009.
2.Qasim S.R. Wastewater Treatment Plant, Planning, Design & Operation Technomic Publications, Newyork, 2002.
3.Manual on "Sewerage and sewage treatment" CPHEEO, ministry of Urban development, Gol, New Delhi 1999.

REFERENCES:

1. Metcalf & Eddy, INC , "wastewater Engineering treatment and Reuse. Third edition Tata McGraw-hill publishing company limited, New Delhi, 2003.
2. Qasim S.R. Wastewater Treatment Plant, Planning, Design & Operation Technomic Publications, Newyork,2002.
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105105178/lec43.pf
4. https://nptel.ac.in/courses/105104102/

Course Coordinator **HOD**

U18PECE034	SURFACE HYDROLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Hydraulics Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To impart knowledge on hydrological cycle, spatial and temporal measurement and analysis of rainfall and their applications including flood routing and ground water hydrology.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Measure the rainfall intensity , duration and frequency	E
CO2	Assess the losses of precipitation due to evaporation	E
CO3	Prepare the unit hydrograph for surface run off	An
CO4	Solve the flood routine and channel routine problems	E
CO5	Conduct yield test on aquifers	An
CO6	To understand flood estimation by various concepts.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3			2			3			3	1
	CO2	3	3	2			3			3		3			3
	CO3					1			2		2		1	2	
	CO4	2			3			3				2			2
	CO5	3			3						3			3	1
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

UNIT I HYDROMETEOROLOGY 9

Hydrological cycle -Hydro meteorological factors -Cloud formation- Winds and their movement -types of precipitation.- Forms for precipitation- Density and Adequacy of rain

gauges – Recording and non-recording gauges.

UNIT II PRECIPITATION AND ABSTRACTIONS 9

Spatial distribution – Consistency analysis – Frequency analysis – Intensity, duration, frequency relationships- Evaporation –Infiltration- Norton's equation Infiltration indices – Types of streams – Stage discharge relationships – Flow measurements – Currents meter method for velocity measurements.

UNIT III HYDROGRAPH ANALYSIS 9

Factors affecting the shape of hydrograph- Components of DRH. Baseflow- Unit hydrograph - Scurve hydrograph- Synthetic unit hydrograph.

UNIT IV GROUND WATER HYDROLOGY 9

Occurrence of ground water – Types of aquifer – Dupuifs assumptions – Darcy's law – Estimation of aquifer parameters – Pump tests.

UNIT V FLOOD ANALYSIS 9

Flood estimation – Gumbel's method – log Pearson types III method – Reservoir flood routing, Channel routing, Other methods of routing.

TEXT BOOKS

1. Subramanya K. Engineering Hydrology, Tata McGraw Hill. Publishing Company Limited, 2006

REFERENCES

1. Raghunath H M, Hydrology, Witey Eastern Limited, New Delhi 1998.
2. Vijay Singh P, Elementary Hydrology -Prentice Hall of India, 1998.
3. Mutreja K N, Applied Hydrology, Tata McGraw Hill Publications, New Delhi, 1998.
4. Jayaram Reddy P Hydrology, Tata McGraw Hill Publications, New Delhi, 1998.
5. https://nptel.ac.in/courses/105103026/
6. https://nptel.ac.in/courses/105107129/

Course Coordinator **HOD**

U18PECE035	**REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCE MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydrology and Water Resource Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: This subject deals with the basics of hydrology and also various remote sensing and GIS applications in the field of hydrology and water resources.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study the basic knowledge of hydrologic data.	U
CO2	To study the watershed characteristics and its applications.	U
CO3	To acquire knowledge about irrigation and water quality parameters.	U
CO4	To study the ground water resources mapping by remote sensing & GIS.	U
CO5	To study the surface water resources mapping by remote sensing & GIS.	U
CO6	To Assess Groundwater potential zones and Groundwater mapping.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3				2		2		1	3
	CO2														
	CO3	2	3			2			3				3		2
	CO4									2				2	
	CO5	2			3			3				2			2
	CO6	3			3						3			3	1
3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)					
4	Approval	Meeting of Academic Council, May 2018													

UNIT I FUNDAMENTALS OF HYDROLOGY 9

Hydrological cycle – estimation of various components of hydrological cycle – clouds – rainfall – runoff – evaporation – transpiration – evapotranspiration – interception – depression storage – spectral properties of water – case studies.

UNIT II DRAINAGE BASIN ASSESSMENT 9

Watershed divide – stream networks – Delineation and codification of watersheds – basin morphometric analysis – linear, aerial, relief aspects – Rainfall - runoff modeling – urban hydrology –flood forecasting, risk mapping, damage assessment - soil moisture area – drought forecasting and damage assessment – mitigation- GIS applications for hydrological disaster studies.

UNIT III IRRIGATION AND WATER QUALITY 9

Project investigation – implementation - maintenance stage - location of storage / diversion works – canal alignment – depth - area capacity curve generation - water quality parameters – physical, chemical, biological properties - water quality mapping and monitoring – correlation model for pollution detection and suspended sediment concentration– case studies.

UNIT IV - GROUND WATER RESOURCES APPLICATIONS 9

Types of Aquifers- Formations -confined and unconfined aquifers -Assessment of Groundwater potential zones and Groundwater mapping -Site selection for recharge structures- Hydrogeological Mapping -GIS applications to ground water studies.

UNIT V - SURFACE WATER RESOURCES APPLICATIONS 9

Surface water bodies- lakes, reservoirs, ponds, rivers, channels- mapping- change detection- Water harvesting structures, in-situ and Ex-situ, Mapping and monitoring of catchment and command area, Water logging and salt affected area mapping, Reservoir Sedimentation,

sedimentation control-GIS applications to surface water studies

TEXT BOOKS:

1. Jayaram Reddy, "Engineering Hydrology", 2nd Edition, Laxmi publications Pvt. Ltd., New Delhi reprint 2008.
2. K Subramanya, "Engineering Hydrology", Tata Mc GrawHill Publishing Company Ltd., New Delhi, 3rd Edition, 2008.

REFERENCES:

1. Raghunath .H.M, "*Hydrology – Principles – Analysis – Design",* New Age International Publishers, New Delhi. 2006
2. Ramasamy .S.M, "*Remote sensing in water resources",* Rawat publications, New Delhi ,2005.
3. Murty.V.V.N, "*Land and Water Management Engineering"*, Kalyani Publishers, New Delhi – 2002.
4. Agarwal C.S and Garg.P.K, "*Text Book on Remote Sensing in Natural Resources, Monitoring and Management",* Wheeler publishing Co & Ltd., New Delhi, 2010/
5. https://nptel.ac.in/content/storage2/courses/105105110/pdf/m6l03.pdf
6. https://www.iitr.ac.in/departments/HY/pages/Activities+PGDiploma_and_MTech_programmes.html

Course Coordinator **HOD**

U18PECE036	**PRESTRESSED CONCRETE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Reinforced Concrete Design				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To introduce the need for pre stressing as well as the methods, types and advantages ofprestressing. Students will be introduced to the design of pre stressed concrete structures subjected to flexure.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study the effect of pre-stressing on flexural members	An
CO2	To study the analyze and design procedure for end block	An
CO3	To know about the design of pre-stressed concrete tanks	U
CO4	To understand the concepts of flexural strength of structural members.	U
CO5	To study about the design of pre-stressed concrete bridges	C
CO6	To design anchorage zone reinforcement.	C

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2			3			3				2			2
	CO2	3			3						3			3	1
	CO3	3	2		2			1		2	3		2		3
	CO4	3	3	2			3			3		3			3

	CO5					1			2		2		1	2	
	CO6	2			3			3				2			2
3	Category	Humanities & Social Sciences including Management Courses (HS)		Basic Sciences (BS)		Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**		Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)		Mandatory Courses (MC)	
4	Approval	Meeting of Academic Council, May 2018													

UNIT I INTRODUCTION – THEORY AND BEHAVIOUR 9

Basic concepts – Advantages – Materials required – Systems and methods of prestressing - Study of strength, behavior - design of prestressed reinforced concrete members - structures, with primary emphasis on pretensioned - precast construction emphasis on the necessary coordination between design and construction techniques in prestressing.

UNIT II DESIGN OF END BLOCK 9

Flexural strength – Simplified procedures as per codes – strain compatibility method – Basic concepts in selection of cross section for bending – stress distribution in end block- Design of anchorage zone reinforcement – Limit state design criteria – Partial prestressing - Applications.

UNIT III DEFLECTION AND DESIGN OF ANCHORAGE ZONE 9

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel‟s method, Guyon‟s method and IS1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

UNIT IV DESIGN FOR FLEXURE AND SHEAR 9

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on I.S. 1343 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

UNIT V PRESTRESSED CONCRETE BRIDGES 9

General aspects pretensioned prestressed bridge decks - Post tensioned prestressed bridge decks - Advantages over R.C.bridges - Principles of design only.

TEXT BOOKS:

1. Krishna Raju N., “Prestressed concrete”, Tata McGraw Hill Company, New Delhi, 2007.
2. K.U.Muthu, Azmi Ibrahim, Maganati Janardhana & Vijaya anand, “Prestressed Concrete, Prentice Hall India Learning Private Limited, 2016.
3. Rajagopalan, N, “Prestressed Concrete”, Alpha Science, 2002
4. Lin T.Y. & Ned H.Burns, “Design of prestressed concrete structures”,Wiley IndiaPrivate Limited,2010.

REFERENCES:

1. IS 1343 – 2012 Code of Practice for Prestressed Concrete by Bureau of Indian Standards.
2. Prestressed Concrete Analysis and Design, Naaman, 2nd Edition, Techno Press 3000, 2004.
3. https://nptel.ac.in/courses/105106117/
4. https://www.scribd.com/doc/119985359/CURSO-NPTEL-Civil-Engineering-Pre-Stressed-Concrete-Structures

Course Coordinator **HOD**

U18PECE037	**GEOTECHNICAL DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Foundation Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To impart knowledge on common method of sub soil investigation and design of foundation and to acquire the capacity to investigate the soil condition and to select and design a suitable substructure.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To get well acquainted with the various investigation specifications as per the infrastructure to be build on the proposed site.	An
CO2	To know about the properties of materials required for the constructing a desired infrastructure	U
CO3	To be familiar with design concepts of various foundation systems	An
CO4	To be familiar with design of transportation facilities	An
CO5	To be familiar with methods and tools for structural design, reliability, safety and environmental protection	An
CO6	To identify Problems and solutions to retaining structures.	E

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3				1		3			3	1
	CO2	3	2		2			1		2	3		2		3
	CO3					2								3	
	CO4		2				2		3		2		2		2
	CO5											3			
	CO6	1		2			3			3				3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I SUBSURFACE SITE EVALUATION **9**

Planning of Exploration and experimental programme, investigations, exploration for preliminary design, exploration for detailed design Geo-physical explorations (soundings, probings, boring, boring methods), excavation methods for explorations, ground water investigations, rock boring, miscellaneous exploratory techniques

UNIT II DESIGN OF RETAINIG WALLS 9

Introduction – Design of Retaining structures; Cantilever sheet pile walls; Anchored Sheet pile walls; Braced cuts; Dewatering; Problems and solutions to retaining structures

UNIT III DESIGN OF PAVEMENTS FOR AIRPORTS 9

Factorsaffectingrigid pavements-Design procedures forrigid pavement– Slab thickness,dowel bar, tiebar,spacingofjoints–IRCguidelines–Airfieldpavements– Comparisonofhighwayandairfield pavements.

UNIT IV DESIGN OF DAMS 9

Design steps for of gravity dam sections, Expected loadings for gravity dams, Stability analysis of gravity dam sections, Foundation preparation for gravity dams,

UNIT IV DESIGN OF MARINE STRUCTURES 9

Methods and Tools for Loads and Load Effects;Methods and Tools for Strength Assessment; Experimental Analysis of Structures;Materials and Fabrication of Structures; Methods and Tools for Structural Design and Optimisation; andStructural Reliability, Safety and Environmental Protection.

TEXTBOOKS

1. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore,2003.
2. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

REFERENCES

1. Swami Saran, Analysis and design of substructures: Limit State design (2nd ed). Taylor & Francis, Leiden ; New York, 2006.
2. Bowles J.E. Foundation analysis and design, McGraw Hill, 1994.
3. https://nptel.ac.in/courses/105101001/
4. https://nptel.ac.in/courses/105106142/

Course Coordinator **HOD**

U18PECE038	**CONSTRUCTION EQUIPMENT & AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about the Conventional construction methods.	U
CO2	To know about the types of Advanced manual and automated Equipments.	U
CO3	To study about Prestressing jacks and grouting equipment.	U
CO4	To learn aboutthe various Heavy lifting equipments in the construction.	U

CO5	To know about Equipment Productivities in construction.	U
CO6	To identify uses of Drones for spread out sites.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		2		1				1		2		2	3
	CO2			3				3			3				
	CO3					2			2			2		2	
	CO4	3			3						3			3	1
	CO5	3	2		2			1		2	3		2		3
	CO6	3	3	2			3			3		3			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Factors affecting selection of equipment and methods – Technical and economic – Construction engineering fundamentals – Analysis of production and output costs;Conventional construction methods, Mechanized methods comparison of construction and Mechanized methods and advantages of latter;

UNIT II EQUIPMENT FOR EARTHWORK 9

Advanced manual and automated Equipment used for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Fundamentals of Earth Work Operations - Earth Moving operations-Types of Earthwork Equipment - Tractors, Motor Graders, Scrapers, Front end Loaders, Earth Movers – capacity calculations.

UNIT III OTHER CONSTRUCTION EQUIPMENT 9

Advanced and latest technology adopted in the plastering machines; Prestressing jacks and grouting equipment; Equipment for Dredging, Trenching, Tunneling, Drilling and Blasting. Equipment for compaction - Types of pumps used in Construction - Equipment for Grouting - Pile Driving Equipment- Equipment of Erection and demolition.

UNIT IV MATERIAL HANDLING EQUIPMENT 9

Heavy lifting equipments in the construction, Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Forklifts and related equipment - Portable Material Bins - Conveyors - equipment used in demolition – Chain Pulley Blocks. Crushers – Feeders - Screening Equipment - Batching and Mixing Equipment – Hauling equipment - Pouring and Pumping Equipment – Ready mixed concrete carriers.

UNIT V AUTOMATION IN CONSTRUCTION 9

Automation in construction, objective of automation, advantage and disadvantage of

Automation in construction. Equipment Productivities; Use of Drones for spread out sites; Use of robots for repetitive activities.

TEXT BOOKS:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2006.
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008.

REFERENCES:

1. Construction Equipment and Methods: Planning, Innovation**,** by Leonhard E. Bernold, 2015.
2. Varghese , P.C. Building construction, Prentice Hall of India Pvt. Ltd, New Delhi, 2007.
3. https://nptel.ac.in/courses/105103093/
4. https://nptel.ac.in/courses/105103023/

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE - IV (PE – IV)

U18PECE041	**TRAFFIC ENGINEERING & MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To give an overview of Traffic engineering, traffic regulation, management and traffic safety with integrated approach in traffic planning as well. To deal with problems in mixed traffic flow and case studies on accident analysis, accident statistical data, methods of representing accident rate.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Analyse traffic problems and plan for traffic systems various uses.	An
CO2	Respond to the situations where short reports and instructions are required.	C
CO3	Design Channels, Intersections, signals and parking arrangements.	C
CO4	Develop our confidence and authority in the practical use of language.	C
CO5	To understand the importance of traffic hazards.	U
CO6	To learn the Significant roles of Traffic control personnel.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				2			3			3			3
	CO2		2		2									2	
	CO3	3	2		2			1		2	3		2		3
	CO4					2								3	
	CO5	2	2				2		3		2		2		2
	CO6	1										3			

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: TRAFFIC PLANNING AND CHARACTERISTICS **9**

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town ,country ,regional and all urban infrastructure – Towards Sustainable approach – land use & transport and modal integration.

UNIT II: **TRAFFIC SURVEYS** **9**

Traffic Surveys – Speed, journey time and delay surveys – Vehicles - Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance

.

UNIT III: **TRAFFIC DESIGN AND VISUAL AIDS** **9**

Intersection Design - channelization, Rotary intersection design – Signal design – Coordination of signals — Grade separation - Traffic signs including VMS and road markings – Significant roles of Traffic control personnel - Networking pedestrian facilities & cycle tracks.

UNIT IV: **TRAFFIC SAFETY AND ENVIRONMENT9**

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT V: **TRAFFIC MANAGEMENT** **9**

Area Traffic Management System - Traffic System Management (TS) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods Congestion and parking pricing – All segregation methods- Coordination among different agencies– Intelligent Transport System for traffic management, enforcement and education.

TEXTBOOKS:

1. Alexa Delbosc and William Young, “Traffic engineering and Management, Monarsh University, 2017.
2. V.Sanakara Subramaniyan, “Traffic Engineering and Management”, Lakshmi Publications, 2013.
3. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2011.
4. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
5. Salter. R.I and Hounsell N.B, " Highway Traffic Analysis and design", Macmillan Press Ltd.1996.

REFERENCES:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd., New Delhi, 2011
2. Hobbs.F.D. "Traffic Planning and Engineering", University of Birmingham, Peragamon Press Ltd, 2005
3. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994
4. John E Tyworth, "Traffic Management Planning, Operations and control", Addison Wesly Publishing Company, 1996 .
5. Taylor MAP and Young W, " Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998.
6. https://nptel.ac.in/courses/105107123/
7. http://www.nptelvideos.in/2012/11/transportation-engineering-ii.html
8. https://theconstructor.org/transportation/sight-distance-highway-engineering/10977/

Course Coordinator **HOD**

U18PECE042	**SUSTAINABLE CONSTRUCTION METHODS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To learn the Modular construction methods for repetitive works.	U
CO2	To know about the Precast concrete construction methods.	U
CO3	To learn to Identify cutting edge sustainable construction materialsand technologies.	U
CO4	To learn about highly successful recent green construction projects.	U
CO5	To know about the design, evaluation, and production of green construction materials.	C & E
CO6	To learn the Preparation for the LEED Green Associate professional licensing exam.	U & R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		3				3		1	3		3	2	
	CO2	3				3			2			3			3
	CO3									3			2		
	CO4	2	2		2		2					2		2	2
	CO5	3	2		2			1		2	3		2		3
	CO6			1		2						1		3	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls); Modular construction methods for repetitive works;

UNIT II SUSTAINABLE METHODS OF CONSTRUCTION 9

Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges;

UNIT III TECHNIQUES AND EVELUATION 9

Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.

UNIT IV GREEN BUILDING CONCEPTS 9

Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.

UNIT V ENVIRONMENTAL IMPACT 9

Environmental impact of materials; life-cycle assessment; material selection to optimize performance; design, evaluation, and production of green construction materials.

TEXT BOOKS:

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2001.
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi,2007.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995.
4. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
5. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
6. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.

REFERENCES:

1. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery,John Wiley & Sons,2005.
2. Lynne Elizabeth, Cassandra Adams “Alternative Construction : Contemporary Natural Building Methods ”, Softcover, Wiley & Sons Australia, Limited, John,2005.
3. https://www.smartcitiesdive.com/ex/sustainablecitiescollective/best-practice-sustainable-construction/166496/
4. https://www.pmi.org/learning/library/sustainability-construction-industry-7099
5. https://nptel.ac.in/courses/105102195/

Course Coordinator HOD

U18PECE043	**SOLID AND HAZARDOUS WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To educate the students on the principles involved in the management of municipal solid waste and hazardous wastes- from source identification up to final disposal.

COURSE OUTCOMES (COs):		**Revised Bloom’s Taxonomy**
CO1	Understand the fundamentals Types and Sources of solid and hazardous wastes.	U
CO2	Understand about Waste generation rates and variation-Composition, physical, chemical and	U

	biological properties of solid wastes	
CO3	Understand the Handling and segregation of wastes at source- storage and collection of municipal solid wastes.	U
CO4	Improve the Objectives of waste processing- material separation and processing technologies.	Ap
CO5	Know the Waste disposal options- Disposal in landfills.	R
CO6	To understand the Need for transfer and transport.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			2		2			3				2	3
	CO2		1								3		3		
	CO3	2			3			2						1	3
	CO4								1	3			2		
	CO5	2	2		2		2					2		2	2
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management- Elements of integrated waste management and roles of stakeholders- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, plastics and fly ash,financing waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 9

Waste generation rates and variation-Composition, physical, chemical and biological properties of solid wastes- Hazardous Characteristics- TCLP tests- waste sampling and characterization plan- source reduction of wastes- Recycling and reuse- waste exchange.

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES 9

Handling and segregation of wastes at source- storage and collection of municipal solid wastes- Analysis of collection systems- Need for transfer and transport- Transfer stations Optimizing Waste allocation- compatibility, storage, labeling and handling of hazardous wastes- hazardous waste manifests and transport.

UNIT IV WASTE PROCESSING TECHNIQUES 9

Objectives of waste processing- material separation and processing technologies- biological and chemical conversion technologies-method and controls of composting- thermal conversion technologies and energy recovery- incineration- solidification and stabilization of hazardous wastes- treatment of biomedical wastes.

UNIT V WASTE DISPOSAL 9

Waste disposal options- Disposal in landfills- Landfill Classification, types and methods- site selection- design and operation of sanitary landfills, secure landfills and landfill bioreactors- leachate and landfill gas management- landfill closure and environmental monitoring- closure of landfills- landfill remediation.

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw- Hill International edition, New York, 2000.
2. M.N. Rao, Razia Sultana, Sriharsha Kota Solid and Hazardous Waste Management, Science and Engineering, , BSP Publishers, 2017
3. Kanthi. L. Shah, Basics of Solid and Hazardous Waste Management Technology, 2000

REFERENCES:

1. CPHEEO "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
2. Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans Environmental Resources Management, Hazardous waste Management, McGraw- Hill International edition, New york, 2001.
3. Vesilind P.A., Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.
4. https://nptel.ac.in/courses/105106056/
5. https://ec.europa.eu/environment/waste/studies/pdf/climate_change.pdf
6. https://www.epa.gov/homeland-security-waste/waste-management-options-homeland-security-incidents

Course Coordinator **HOD**

U18PECE044	**PIPELINE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Fluid mechanics				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To educate the students in detailed design concepts related to water transmission mains, water distribution system and buried pipes with emphasis on computer application.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To gain knowledge about water supply systems	Ap
CO2	To be able to understand hydraulic principles	U
CO3	To design storm water distribution network.	C
CO4	To to analyze pipe network problems using computer software .	An
CO5	The students will be able to get a basic knowledge of the design of pipe networks.	C & Ap
CO6	To understand the Basic equations of unsteady flows.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

2	CO1		2				2			3			2		3
	CO2	2	2		2		2					2		2	2
	CO3	3	2		2			1		2	3		2		3
	CO4	2			3			2						1	3
	CO5								1	3			2		
	CO6	2	2		2		2					2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I WATER SUPPLY SYSTEMS 9

Water requirement – sources of water – water demand – reservoir storage – nodal hydraulic gradient level values - water supply consideration, Types of water supply systems- piping system- distribution network- labeling- network components – Network models – design – optimization in practice.

UNIT II HYDRAULIC PRINCIPLES AND NETWORK PARAMETERS 10

Energy and hydraulic gradient lines – head loss in links – equivalent pipes – series – parallel pipes – path head loss and loop head loss – analysis of water distribution network- static node, dynamic node – network performance – flow analysis - Layout – in situ lining - pipes material – appurtenances – minimization of water losses – leak detection.

UNIT III STORM WATER DISTRIBUTION AND BURIED PIPES 9

Planning – runoff estimation – rainfall data analysis – storm water drain design Introduction to Buried pipes – external loads – gravity flow design, pressurized flow- rigid and flexible pipes – installation – trenchless technology

UNIT IV RELIABILITY ASSESSMENT AND DESIGN 8

Uncertainty and reliability – affecting events- assessment – reliability parameters- configurations. Design methodology - strengthening and expansion

UNIT V FLUID TRANSIENTS 9

Basic equations of unsteady flows through closed conduits. Method of characteristics. Transients caused by centrifugal pumps and hydroelectric power plants.

TEXT BOOKS

1. Bhave P. R, "Optimal design of water distribution networks", Narosa publishing House, New Delhi, 2003
2. Bajwa. G. S, "Practical handbook on Public Health Engineering", Deep publishers, Shimla 2003
3. Manual on water supply and treatment", CPHEEO, Ministry of Urban Development, GOI,New Delhi, 1999

REFERENCES:

1. B.A. Hauser, "practical hydraulics" Hand Book, Lewis Publishers, New York, 1991
2. Moser A. P, "Buried pipe Design", 3rd Edition, American Water Works Association

3. Robert van Bentum and Lan K. Smout, "Buried Pipe lines for surface Irrigation", The Water, Engineering and Development Centre, Intermediate Technology Publications,UK,1994
4. Wurbs R.A., and James W.P. "Water Resources Engineering". Prentice Hall of India, Eastern Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/98WR01377
5. https://becht.com/articles/fluid-transients-in-piping-systems-1
6. https://ascelibrary.org/doi/book/10.1061/9780784407455

Course Coordinator **HOD**

U18PECE045	**URBAN HYDROLOGY AND HYDRAULICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydraulic Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: The primary objective is the demonstration and understanding of the fundamental concepts and processes associated with the hydraulic and water quality design, operation and performance aspects of urban drainage systems.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To develop understanding in current urban pollution problems, and to identify mitigation/rehabilitation measures	U
CO2	Students will gain a sound understanding of the modelling tools, which can be used to aid decision-making in urban water and urban pollution management	U
CO3	To get experience in the use of modelling tools through applications within the Integrated Project case studies	Ap
CO4	Students will be familiar with human influences on the quantity and quality of stormwater runoff from urban catchment	Ap
CO5	Able to apply continuity, energy and momentum principles to the analysis of flows and design of stormwater infrastructure	Ap
CO6	To understand the Computer models for urban storm water modeling in software applications.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1			3			3		1	3			2		1
	CO2	2	2		2		2					2		2	2
	CO3	3	2		2			1		2	3		2		3
	CO4	3				2			3			3			3
	CO5		2		2									2	
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I URBANIZATION 9

Introduction - Urbanization -Stormwater runoff quantity and quality issues – Rainfall design for urban catchments – Hydrologic and probabilistic description of rainfall – Design rainfall – Methods for construction of design storm hyetographs – Rainfall excess calculations – Computation of abstractions –Combined loss models. Calculation of runoff rates-basic concepts – elements of urban runoff hydrographs – Time of Concentration –Definition and calculation by various methods – Unit hydrograph method – NRCS method

UNIT II OPEN CAHNNEL FLOW 9

Open-channel flow – Definitions - States of open channel flows – Open Channel flow equations – Steady Gradually varied flow – Normal flow – Open channel rating curve – Overland flow – Kinematic wave model – overland flow on impervious and pervious surfaces – Channel flow routing– simplified and numerical models

UNIT III DESIGN OF DRAINAGE STRUCTURES 9

Design of storm water drainage structures –Drainage design for street pavements – Storm sewer systems – Culverts – Surface drainage channels Urban flooding and associated issues – Detention basins – Stage-discharge relationship - Detention basin design - Infiltration structures- Infiltration basins, Trenches

UNIT IV STORM WATER MODELS 9

Strom water quality control - Concepts of Best management Practices(BMP)and Low Impact developments(LID) – Advantages – Computer models for urban storm water modelling – Public domain and general packages of HEC-HMS, HEC-GeoHMS, EPASWMM.

UNIT V HYDRAULIC ANALYSIS OF DRAINAGE STRUCTURES 9

Hydraulic analysis and design of urban, highway, airport, and small rural watershed drainage problems;runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts.

TEXT BOOKS

1. Osman Akan, A and Robert J. Houghtalen, Urban Hydrology, Hydraulics, and Stormwater Quality: Engineering Applications and Computer Modeling, John Wiley and Sons, revised edition, 2013
2. Ven T Chow, David Maidment, and Larry Mays, Applied hydrology, Tata Mc-graw Hill, First edition, 2011

REFERENCES

1. National Engineering Handbook, Part 630, Natural Resources Conservation Service, United States Department of Agriculture
2. Storm Water Management Model Applications Manual, USEPA - EPA/600/R-09/077, July 2009
3. HEC-HMS Technical Reference Manual, US Army Corps of Engineers, CPD-74B, March 2013.

4. https://nptel.ac.in/courses/105101002/
5. https://flh.fhwa.dot.gov/resources/design/pddm/Chapter_07.pdf
6. https://www.integratedstormwater.eu/sites/www.integratedstormwater.eu/files/materials/urbanhydrology_by_juanjo_galan_aalto_university.pdf

Course Coordinator **HOD**

U18PECE046	**METAL STRUCTURAL BEHAVIOUR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: This course deals with some of the special aspects with respect to Civil Engineering structures using steel material.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Design of plate girders, web and flange design, curtailment of flange plates.	C
CO2	Design of simple and built up columns subject to combined bending and axial loads	C
CO3	Design of light gauge steel sections.	C
CO4	Design of special type of heavy-duty connections for steel frames.	C
CO5	To study shape factor, plastic hinge, plastic moment , plastic analysis of beams.	U
CO6	To Design flexural and compression members applications.	C

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	2		2		2					2		2	2
	CO2	3	2		2			1		2	3		2		3
	CO3	2			3	1		2				2		1	3
	CO4								1	3			2		
	CO5	3	2		2			1		2	3		2		3
	CO6	3				2			3			3		1	3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 COMBINED BENDING AND AXIAL LOADS 9

Design of simple and built up columns subject to combined bending and axial loads - design of column base and connections to foundation.

UNIT II PLATE GIRDER 9

Design of plate girders – web and flange design – curtailment of flange plates – Design of stiffeners and splices – tension field action- Design of gantry girder.

UNIT – III DESIGN OF CONNECTIONS 9

Types of connections – Design of framed beam connection – Seated beam connections – Unstiffened, Stiffened seat connections. Continuous beam-to-beam connections and continuous beam-to-column connection both welded and riveted.

UNIT IV PLASTIC THEORY 9

Introduction – shape factor – Moment redistribution – Static, Kinematic and Uniqueness theorems – Combined mechanism – Analysis of single bay and two bay portal frames – Methods of plastic moment distribution – Effect of axial force and shear force on plastic moments – Connections Moment resisting connection – Design of continuous beams.

UNIT V LIGHT GAUGE STEEL SECTIONS 9

Introduction to cold formed steel member geometric properties – Flat width – Effective width concepts, stiffened and un-stiffened compression elements and their stress distribution across the section. Behavior – Design of flexural and compression members.

TEXT BOOKS:

1. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013
2. Shiyekar. M.R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
3. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.

REFERENCES:

1. Narayanan.R.et.al. "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publications, 2002
2. Duggal. S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2005.
3. https://nptel.ac.in/courses/105106053/
4. http://home.iitk.ac.in/~ag/ME721/intro.pdf
5. https://www.researchgate.net/publication/301358504_Plastic_theory_of_structures

Course Coordinator **HOD**

U18PECE047	**INDUSTRIAL STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Foundation Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: This course deals with some of the special aspects with respect to Civil Engineering structures related to industries.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the design of industrial buildings frames	U & C
CO2	To know the analyze and design of chimney, tower	An
CO3	To understand the analysis and design of silos and bunkers	U & An

CO4	To study about the analysis and design of cylindrical shell structures, folded plates	U & An
CO5	To impart the students about the design concept of machine foundation	C
CO6	To get knowledge on Structural design of foundation.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2		2			1		2	3		2		3
	CO2	2			3	1		2						1	3
	CO3		2				2			3			2		3
	CO4	2	2		2		2					2		2	2
	CO5	3	2		2			1		2	3		2		3
	CO6		2				2			3			2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I **9**

Industrial steel building frames - Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents, Pressed steel tank, circular tank

UNIT II **9**

Transmission and Communication towers - Types and configuration - Analysis and design - Chimneys - Loads and stresses in chimney shaft, Earthquake and wind effect - Stresses due to temperature difference, combined effect of loads and temperature, temperature - Design of chimney

UNIT III **9**

Silos and Bunkers - Jassen's theory, Airy's theory, Shallow and deep bins, Rectangular bunkers with slopping bottom, Rectangular bunkers with high side walls - Steel stacks.

UNIT IV **9**

Introduction, force acting on a steel stack, design consideration, design example of stacks - Concrete Shell Structures - Folded plate and cylindrical shell structures - Introduction, structural behaviour of long and short shells, beam and arch action - Analysis and design of cylindrical shell structures - Analysis and design of folded plates.

UNIT V **9**

Machine foundations – Introduction to machine vibration - Structural design of foundation to rotary machines, impact machines, vibration characteristics - Design consideration of foundation to impact machine, grillage, pile and raft foundation.

TEXT BOOKS:

1. Ramamrutham.S., “Design of Reinforced Concrete Structures”, Dhanpat Rai Publishing Pvt.Ltd.
2. Varghese.P.C., ” Limit State Design of Reinforced Concrete”, Prentice Hall.
3. Bhavikatti.S.S., “Design of Steel Structures”, J.K. International Publishing HousePvt.Ltd

REFERENCES:

1. Henn W. “Buildings for Industry”, Vol.I and II, London Hill Books.
2. Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Ltd.SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards.
3. https://nptel.ac.in/courses/105105162/
4. https://www.researchgate.net/publication/305247433_What_Is_Industrial_Structure

Course Coordinator **HOD**

U18PECE048	**ENVIRONMENTAL GEOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Geotechnical Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To develop an understanding of the geotechnical aspects in the disposal of wastematerials and the remediation of environmentally contaminated sites.

COURSE OUTCOMES (COs):		**Revised Bloom’s Taxonomy**
CO1	Learn the concept of interaction between waste and soiland pollutant movement in the ground.	U
CO2	Get familiarized with the role of geotechnical engineering in waste management.	R
CO3	Have an exposure to various waste disposal methods	R
CO4	Understand the landfills and land fill liners	U
CO5	Understand the relevance of various ground remediation technologies	U
CO6	To get knowledge on Ground water remediation technologies.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		3			3			3		2		2	3
	CO2				2				1	3			2		
	CO3	3	2		2			1		2	3		2		3
	CO4	3				2			3			3		1	3
	CO5	2	2		2		2					2		2	2
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION **9**

Introduction to environmental geotechnology , Environmental cycles & interaction, Soil water environment interaction, Causes of soil pollution, Factors governing soil pollutant interaction

UNIT II SOURCES OF WASTES ANDCONTAMINANT TRANSPORT9

Waste characteristics - Sources and types of wastes, Contaminant transport in sub surface : advection, diffusion, dispersion, Contaminant transformation : sorption, biodegradation, ion exchange, precipitation, Ground water pollution : pollution of aquifers bymixing of liquid waste – protecting aquifers.

UNIT III WASTE DISPOSAL METHODS **9**

Objectives of waste disposal facilities – site selection, criteria for waste disposal, Methods of disposal: surface impoundment systems, Sub-surface disposal, passive containment systems, landfills.

UNIT IV: LANDFILLS **9**

Landfill – types, requirements, components – Siteselection, Leachate and gas generation – primary and secondary, leachate, Leachate collection and removal system– gas collection and removal system, Landfill liners – compacted clay liners, geosyntheticclay liners, geomembrane liners.Landfill cover system – end uses of closed landfills.

UNIT V:GROUNDREMEDIATIONTECHNOLOGIES **9**

Soil remediation technologies: soil washing, Electrokinetic remediation, Soil vapour extraction, bioremediation, stabilization, and solidification, Ground water remediation technologies, Pump and treat, insitu flushing, bioremediation, air sparging, reactive well.

TEXT BOOKS

1. Hsai- Yang Fang, "Introduction to Environmental Geotechnology,- CRC Press", New York, 2009.

REFERENCES:

1. David. E. Daniel, "Geotechnical practice for waste disposal"– Chapman and Hall – London, 1993.
2. Wentz .C.A, Hazardous, "Waste Management", McGraw Hill Publishing Company, Singapore, 1989.
3. https://www.sciencedirect.com/science/article/pii/S1110062118301375
4. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105105178/lec16.pf

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE - V (PE – V)

U18PECE051	**PAVEMENT DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Reinforced Concrete Design				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, he/she will be in a position to assess quality and serviceability conditions of roads. Also get familiar with pavement design methods for highways and airports.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know the different types of pavements.	R
CO2	Understand the importance of stress distribution.	U
CO3	To learn the design procedures of rigid pavements.	An
CO4	To learn the design procedures of flexible pavements.	An
CO5	To evaluate the performance and maintenance of the pavements.	E
CO6	To get knowledge on Testing and field control Stabilization for rural roads in India.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3		3				3			3			3	3
	CO2	2				2		2		2		2			
	CO3			2					3		2			3	2
	CO4	1	2				2			3			2		3
	CO5	2	2		2		2					2		2	2
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

UNIT I: TYPE OF PAVEMENT AND STRESS DISTRIBUTION 8

Introduction – Pavement as layered structure – Pavement types rigid and flexible. Resilient modulus - Stress and deflections in pavements under repeated loading.

UNIT II DESIGN OF FLEXIBLEPAVEMENTS 10

Flexible pavement design factors influencing design of flexible pavement, Empirical - Semi empirical and theoretical methods – Design procedure as per IRC guidelines Design and specification of rural roads.

UNITIII DESIGN OF RIGID PAVEMENTS 9

Cement concrete pavements factors influencing CC pavements Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.

UNITIV PERFORMANCE EVALUATION &MAINTENANCE 9

Pavement Evaluation - causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural - Evaluation by Deflection Measurements Pavement Serviceability index - Pavement maintenance (IRC Recommendations only).

UNIT V STABILIZATION OFPAVEMENTS 8

Stabilization with special reference book to highway pavements – Choice of stabilizers – Testing and field control Stabilization for rural roads in India – use of Geosynthetics in roads.

TEXTBOOK:

1. Khanna, S.K., Justo C.E.G. and Veeraragavan. A., "Highway Engineering", NemChand and Brothers, 10th Edition, Roorkee, 2014.
2. Kadyali, L.R. Principles and Practice of Highway Engineering", Khanna tech.Publications, New Delhi, 2013.
3. Wright P.H. "Highway Engineers", John Wiley and Sons, Inc., New York, 1996.

REFERENCES:

1. Rajib B.Mallick, Tahar El-Korchi, "Pavement Engineering: Principles and Practice, 2nd Edition, CRC Press, 2013.
2. IRC-37–001, Indian roads Congress, Guidelines for the Design of Flexible Pavements, New Delhi, 2001.
3. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000.
4. IRC 58-1998. The Indian Road Congress, Guideline for the Design of Rigid Pavements for Highways, New Delhi, 1991.
5. https://drive.google.com/file/d/1X41yOxW56wV1Vp_ZQVvF7wbfJOO2G0t9/w
6. https://archive.org/stream/textbookonroadsp00spalrich?ref=ol#page/8/mode/2up

Course Coordinator **HOD**

U18PECE052	**CONSTRUCTION ENGINEERING MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Building Materials & Testing Methods				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To learn about properties of most common and advanced building materials and to understand the typical and potential applications of these materials.		
COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about Concretes and behaviour of concretes.	U
CO2	To know about Coatings to reinforcement and anticorrosive polymer coating,	U
CO3	To learn about composites materials used in construction.	R
CO4	To know about Water Proofing Compounds.	R
CO5	To know about Smart and Intelligent Materials for intelligent buildings.	R
CO6	To learn the Application of carbon fibre reinforced polymers and glass fibre reinforced polymers.	R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				2			3			3		1	3
	CO2	2	2		2		2					2		2	2
	CO3	3	2		2			1		2	3		2		3
	CO4	2		2				2				2		1	
	CO5			2					3		2			3	2
	CO6	1	2				2			3			2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I BUILDING MATERIALS 9

Stone as building material; Requirement of good building stones, Deterioration and Preservation of stone work. Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; Mortar: types and requirements.Concretes, - High Strength and High Performance Concrete – Fibre Reinforced Concrete- Light weight concrete - Polymer concrete - Self compacting concrete – Vaccum concrete - Alternate Materials to concrete

UNIT II METALS 9

Steels – New Alloy Steels – Aluminum and its Products –Coatings to reinforcement – anticorrosive polymer coating, anticorrosive treatment inhibited cement slurry coating, cement polymer composite coating and epoxy coated reinforcement – Applications.

UNIT III COMPOSITES 9

Composition – Constitutents – mouldings methods – tooling materials and their selection - Plastics – Representative polymers - Reinforced Polymers – Fibre reinforced polymer (FRP) – Fibre process and moulding process – Application of carbon fibre reinforced polymers and

glass fibre reinforced polymers.

UNIT IV OTHER MATERIALS 9

Polymers in Civil Engineering-Structural Plastics And Composites- Polymer MembranesCoatings-Adhesives, Non - Weathering Materials-Flooring And Facade Materials-Glazed Brick, Photo Catalytic Cement, Acid Etched Copper And Composite Fiber. Precast Flat Panel System, 3d Volumetric Construction, Tunnel Boring Methods, Precast Foundations. Fabrication of Pre Cast And Pre Stressed Components.3 D printing, Recycling of Construction and Demolition wastes.

UNIT V SMART AND INTELLIGENT MATERIALS 9

Smart and Intelligent Materials for intelligent buildings - Matrix tool for assessing the performance of intelligent buildings –Intelligent buildings technology – Thermal comfort , Visual comfort and Indoor air quality – climate , building-climate interaction - Energy Management systems – Smart BuildingsEvalution Tool.

TEXT BOOKS:

1. Sushil Kumar "Building Materials and construction", 20th edition, reprint 2015, Standard Publishers.
2. Dr. B.C.Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi, 2012
3. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India, 2017.

REFERENCES:

1. Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.
2. S.K.Duggal, "Building Materials", (Fourth Edition)New Age International (P) Limited, 2016.
3. national building code of india 2016 (nbc 2016).
4. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
5. M. S. Shetty, "Concrete Technology", S. Chand & Co. New Delhi, 2007.
6. https://easyengineering.net/ce6401-construction-materials-cm_15/
7. https://drive.google.com/file/d/140fhAAWFw-MEDHcc-JSqAshTgRYmtB5p/view

Course Coordinator HOD

U18PECE053	**AIR , NOISE POLLUTION AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: This subject covers the sources, characteristics and effects of air and noise pollution and the methods of controlling the same. The student is expected to know about source inventory and control mechanism.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals characteristics and effects of air and noise pollution and the methods of controlling the same	U
CO2	To understand about the ambient air quality standards and air quality monitoring	
CO3	To know the Removal of gaseous pollutants by adsorption, absorption, reaction and other methods	R

CO4	To improve the knowledge Basics of acoustics and specification of sound	R
CO5	To know about the Psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes	R
CO6	To learn the Biological air pollution control technologies.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2		2			1		2	3		2		3
	CO2	2			3	1		2						1	3
	CO3		2				2			3			2		3
	CO4	2	2		2		2					2		2	2
	CO5	3	2		2			1		2	3		2		3
	CO6		2				2			3			2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect..

UNIT II AMBIENT AIR QUALITY STANDARDS AND AIR QUALITY MONITORING 9

Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles

UNIT III REMOVAL OF AIR POLLUTANTS 9

Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies.

UNIT IV NOISE POLLUTION 9

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation;

UNIT V NOISE POLLUTION CONTROL 9

Psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.

Noise control methods.

TEXT BOOKS:

1.Air Pollution Control Engineering, Keshav Kant, Khanna Publishing House Keshav Kant, Rajni Kant 2018
2. Anjaneyulu D., "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002.
3. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi,2003
4. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi, 1996.

REFERENCES:

1. Stern A.C. *ed*, " Air Pollution Vol. I, II & III", Academic Press, New York, 1968
2. Cunniff P.F, "Environmental Noise Pollution", John Wiley & Sons, New York. 1977.
3. Docks H.M., "Environmental Pollution", John Wiley & Sons. New York 1981.
4. Chanlett T Emit,"Environmental Protection", McGraw Hill series in Water Resources and Environmental Engineering, New York. 1973.
5. Patrick C.F,"Environemental noise pollution", John Wiley & Sons, 1977.
6. https://gradeup.co › air-noise-pollution-study-notes-for-civil-engineering-i.
7. https://www.europarl.europa.eu › factsheets › sheet › air-and-noise-pollution
8. https://www.springer.com

Course Coordinator **HOD**

U18PECE054	**TRANSIENTS IN CLOSED CONDUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydrology and Water Resources Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To equip the students with the comprehensive knowledge of concepts of unsteady closed conduit flow by building on their steady flow understanding of the subject which was introduced to them in their undergraduate curriculum. Emphasis should be on use of computer programs for transient analysis.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Solve simple and varied hydraulic problems related to surge problems.	E
CO2	Formulation of boundary conditions for transient analysis.	E
CO3	Transient analysis for penstocks of hydroelectric schemes.	An
CO4	Design of air chambers, air valves, pressure regulating valves for transient loads.	C
CO5	To create software awareness for transient analysis.	C
CO6	To get awareness about commercially available software for transient analysis.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	2		2		2					2		2	2
	CO2	3	2		2			1		2	3		2		3
	CO3	2		2				2				2		1	

	CO4			2					3		2			3	2
	CO5		2				2			3			2		3
	CO6	2	2		2		2					2		2	2
3	Category	Humanities & Social Sciences including Management Courses (HS)		Basic Sciences (BS)		Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**		Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)		Mandatory Courses (MC)	
4	Approval	Meeting of Academic Council, May 2018													

UNIT 1 INTRODUCTION TO PIPE HYDRAULICS 9

Pipes – Hydraulic of pressure flow. Steady state and unsteady state-Darcy's equation for flow thro' pipes. Analysis and design of pipe systems like pipes in series and parallel.

UNIT II PIPE NETWORKS 9

Design of pipes. Pipe networks - Analysis and design using various methods. Use of softwares in design. Practical examples, difficulties and solutions.

UNIT III UNSTEADY FLOW MEASUREMENTS 9

Flow measurements. Concepts of unsteady flow - Basic differential equations of unsteady flow in closed conduits – Solutions by method of characteristics – Algebraic and graphical water hammer. Additional boundary conditions and systems elements.

UNIT IV POWER PLANT HYDRAULICS 9

Methods for controlling transients in closed conduits. Application in Lift Irrigation, Hydropower, Urban and Rural water supply – Power Plant Hydraulics.

UNIT V FLUID TRANSIENTS 9

Formulation of boundary conditions; transients in pumping mains (power failure; pump start up); transients in penstocks of hydro-electric schemes; analysis for transient control using surge tanks;

TEXT BOOKS:

1. RW Fox & McDonald AT, "Introduction to Fluid Mechanics"– John Wiley, 2011
2. SW Yuan, "Foundations of Fluid Mechanics"- Prentice-Hall (India), 1988

REFERENCES:

1. Fluid Mechanics –Feathertone and Nallulri,2016
2. Hydraulic transients – Streeter ,McGraw-Hill, 2007
3. Fluid Mechanics – Wiley & Streeter,1996.
4. https://mountainscholar.org › bitstream › handle
5.https://baywork.org › 2017/07 › Hydraulics-Webinar-Slides_6-21-17
6. https://www.ijirset.com › upload › july › 323_Hydraulic

Course Coordinator HOD

U18PECE055	**WATER & WASTE WATER TREATMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**

	Prerequisite: Physico-Chemical Processes for Water and Wastewater Treatment
	Course Coordinator Name & Department:

COURSE OBJECTIVES: To impart knowledge on fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Transportation through conduits and open channel and its design	C
CO2	Design of distribution system	C
CO3	Flow estimation, conventional and model based design of sewer pumps and pumping stations	An
CO4	Advances in Sewage Treatment.Removal of organic contents	U
CO5	Design of storm water drainage systems, inlets, storm water pumping, operation and maintenance.	C
CO6	To get knowledge on Biological treatment methods.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1			2					3		2			3	2
	CO2		2				2			3			2		3
	CO3	2	2		2		2					2		2	2
	CO4		2				2			3			2		3
	CO5	2	2		2		2					2		2	2
	CO6	3	2		2			1		2	3		2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I TRANSPORT OF WATER 9

Transportation through conduits and open channel and use of same for the design, operation and maintenance of these systems. - Unit operations and processes - Principles, functions and design of flash mixers, floculators, sedimentation tanks and filters. Disinfection - Aeration – iron and manganese removal, defluoridation and demineralization – Water softening.

UNIT II WATER SUPPLY SYSTEM 9

Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution system, distributing and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operations.

UNIT III SANITARY SEWERAGE SYSTEMS 9

Flow estimation, sewer material, hydraulics of flow in sewer, sewer layout, sewer transitions, materials of sewer, appurtenances, manholes, sewer design, conventional and model based

design sewer pumps and pumping stations, corrosion prevention, operation and maintenance and safety.

UNIT IV SEWAGE TREATMENT

Primary Treatment– Unit Operations & Processes – Principles, functions and design of screen, grit chambers and primary sedimentation tanks.Secondary Treatment – Activated Sludge Processes and Trickling filter, Other treatment method. Stabilisation of Ponds and Septic tanks. Advances in Sewage Treatment.Removal of organic contents : Biological treatment methods, aerobic and anaerobic, digestion, tickling filters, stabilization ponds, activated sludge process – oxidation ditch.

UNIT V STORM WATER DRAINAGE SYSTEMS 8

Drainage lay-out, storm-run-off estimation hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance.

TEXT BOOKS

1. Garg S.K.Environmental Engineering, Vols. I and II, Khanna Publishers, New Delhi..
2. C.S.Shan, Water Supply and Sanitation, Galgotia Publishing Company, New Delhi

REFERENCES

1.. Industrial Water Pollution Control : Eckenfalder W.W. (200) McGraw Hill
2. Waste Water Treatment and Pollution control (1998) Arceivala S.J. Tata McGraw Hill
3. https://ocw.mit.edu › courses › civil-and-environmental-engineering › lect
*4.*https://www.cliffsnotes.com › microbiology › aquatic-microbiology › sewa
*5.*https://www.academia.edu › LECTURE_NOTES_ON_INDUSTRIAL_WAST

Course Coordinator **HOD**

U18PECE056	**EARTHQUAKE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Foundation Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To study the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To understand the concept of vibration of elementary systems	U
CO2	To determine the response MDOF structural system subjected to vibration including earthquake	E
CO3	To know about the concept of seismology and theories	U
CO4	To apply the concept of earthquake resistant design & concept of lateral load distribution on buildings	Ap
CO5	To understand the Base isolation techniques.	U
CO6	To get knowledge on Biological treatment methods.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

2	CO1		2				2			3			2		3
	CO2	2	2		2		2					2		2	2
	CO3		2				2			3			2		3
	CO4			2					3		2			3	2
	CO5		2				2			3			2		3
	CO6	2	2		2		2					2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I THEORY OF VIBRATIONS **9**

Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom -SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation Free vibration of SDOF system

UNIT II MULTIPLE DEGREE OF FREEDOM SYSTEM **9**

Response to harmonic excitation - Impulse and response tounit impulse - Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration - Natural frequencies - Mode shapes -Introduction to MDOF systems - Decoupling of equations of motion – Concept of mode superposition (No derivations); Elements of Seismology; Causes of Earthquake – Geological faults

UNIT III ELEMENTS OF SEISMOLOGY **9**

Tectonic plate theory - Elastic rebound – Epicentre - Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes;

UNIT IV DESIGN SPECTRA **9**

Response of Structures to Earthquake- Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum – Effect of soil properties - damping - Liquefaction of soils - Importance of ductility.

UNIT V DESIGN METHODOLOGY **9**

Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions -Design as per the codes - Base isolation techniques - Vibration control measures – Importantpoints in mitigating effects of earthquake on structures

TEXT BOOK

1. Chopra, A.K., “Dynamics of Structures – Theory and Applications to Earthquake Engineering”.

2.Agarwal. P and Shrikhande. M., "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd.

3.Mario Paz “Structural Dynamics”, CBS publishers.

REFERENCES

1. Biggs, J.M., “Introduction to Structural Dynamics”, McGraw Hill Book Co., New York.

2.Dowrick, D.J., “Earthquake Resistant Design”, John Wiley & Sons. .

3. Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), IS 456: 2000, BIS, New Delhi.
4. https://lecturenotes.in › notes › 16610-note-for-structural-dynamics-and-ea
5. https://lecturenotes.in › Subjects › Earthquake Engineering
6. https://www.slideshare.net › ifti313 › eq-tips-full

Course Coordinator **HOD**

U18PECE057	**ROCK MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Engineering Geology				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To understand the basics and application of engineering geology technology.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Define the properties (viz., physical, mechanical) of rocks and failure criterion of rockmass.	R
CO2	Use engineering rock mass classification (RMR, Q-system, RQD)	Ap
CO3	Analyse the stress distribution insitu and around an opening in underground structures (viz., mine openings, tunnels).	An
CO4	Understand the application of grout in rocks and bolting	U
CO5	Perform field Instrumentation techniques and laboratory studies. Understand the fundamentals of ground subsidence.	Ap & U
CO6	To learn the Theory of Wave Propagation.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	2		2		2					2		2	2
	CO2		2				2			3			2		3
	CO3	2	2		2							2		2	2
	CO4	2	2		2						3	2		2	2
	CO5		2				2			3			2		3
	CO6	2	2		2		2					2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I - INDEX PROPERTIES OF ROCK **9**

Introduction , Physical Properties of Rocks, Mechanical Properties of Rocks, Elastic Parameters of Rocks, Dynamic Property of Rocks, Static and Dynamic Module

UNITII - ROCK STRENGTH **9**

Types of Waves –Compressive – Measurements, Theory of Wave Propagation, Factors influencing Wave Velocity in Rock Mass, Modest of Rock Failure, Strength of Rock, Shear – Tensile – strength measurements, Compressive – strength Measurements.

UNIT III - DEFORMABILITY OF ROCKS AND STRESS **9**

Stress-Strain Behavior, Initial Stress, Influence of Joints, Distribution of Stresses, Measurements of Initial Stresses

UNIT IV -ROCK GROUTING **9**

Introduction, Grouting, Types of Grouting, Grouting materials, Operations and equipments, Pre grouting , Rock Bolt -Types – Systems, Testing of Rock Bolts.

UNIT V - ROCK ENGINEERING **9**

Introduction, Application, Merits and Demerits, Tunneling, Rock Openings, Rocks for Mining Subsidence, Dam and reservoir, Road Cuts, Slabs and Foundations.

TEXT BOOKS

1. Jaeger .C, "*Rock Mechanics for Engineers"*, Cambridge University Press, 2012.
2. Debasis Deb and Abiram Kumar Verma, Fundamentals and Applications of Rock Mechanics, Prentice Hall International, 2016

REFERENCE BOOKS

1.Goodman .P.E, "*Introduction of Rock Mechanics"*, John Wiley and Sons, 1989.
2.Stillburg, "*Professional User Handbook for Rock Bolting"*, Tran Tech Publications, 1989.
3.Brow .E.T, Rock Characterisation, "*Testing and Monitoring*", Pergman Press, 1981.
4.Hock and Bray.J, "*Rock Slate Engineering"*, Institute of Mining and Metallurgy", 1981.
5.https://www.slideshare.net › engineering-rock-mechanics-volume1
6.https://www.slideshare.net › engineering-rock-mechanics-volume1
7.https://lecturenotes.in › download › material › 25703-rock-mechanics-i

Course Coordinator **HOD**

U18PECE058	**STRUCTURAL DYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Structural Analysis II				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To impart knowledge to establish the equations of motion and for the determination of structural response from dynamic loads and experience in the modeling and calculation of dynamic response for simple structural systems.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the discrete single-degree freedom system and calculation of the free and forced response of these systems	U & E
CO2	To study about the discrete multiple-degree freedom system and calculation of the free and forced response of these systems	U & E
CO3	To understand about the elements of seismology technique	U & R
CO4	To learn about the different methods for response of structures to earthquake	R
CO5	To know the earthquake design of structures using IS code method	C

CO6	To get knowledge on Detailing for earthquake resistant construction.	U & C

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2	2		2		2					2		2	2
	CO2	3	2		2			1		2	3		2		3
	CO3	2		2				2				2		1	
	CO4			2					3		2			3	2
	CO5	2	2		2						3	2		2	2
	CO6		2				2			3			2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT–ITHEORY OF VIBRATIONS 9

Concept of inertia and damping – Types of Damping – Degrees of freedom – SDOF idealisation – Equations of motion of SDOF system for mass as well as base excitation – Free vibration of SDOF system – Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation - response spectrum concepts; simple inelastic structural systems- single-degree-of-freedom.

UNIT II MULTIPLE DEGREE OF FREEDOM SYSTEM 9

Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).

UNIT III RESPONSE OF STRUCTURES TO EARTHQUAKE 9

Response and design spectra – Design earthquake – concept of peak acceleration – Site specific response spectrum – Effect of soil properties and damping – Liquefaction of soils – Importance of ductility –Methods of introducing ductility into RC structures. Detailing for earthquake resistant construction – ductility criteria.

UNIT IV ELEMENTS OF SEISMOLOGY 9

Causes of Earthquake – Geological faults – Tectonic plate theory – Elastic rebound – Epicentre – Hypocentre– Seismogram – Magnitude and intensity of earthquakes – Magnitude and Intensity scales – Spectral Acceleration - Information on some disastrous earthquakes - Introduction to systems with distributed mass and flexibility.

UNIT V INTRODUCTION TO EARTHQUAKE ENGINEERING

IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquake

on structures.

TEXT BOOKS:

1. Chopra, A.K., “Dynamics of Structures Theory and Applications to Earthquake Engineering”, 4th Edition, Pearson Education.
2. Mario Paz “Structural Dynamics”, CBS publishers.
3. Basics of structural dynamics and A seismic Design by S.R.Damodrasamy and Kavitha.

REFERENCES:

1. Biggs, J.M., “Introduction to Structural Dynamics”, McGraw Hill Book Co., New York.
2. Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), IS 456: 2000, BIS, New Delhi.
3. IS 1893(Part 1):2002 `Criteria for Earthquake Resistant Design of Structures : Part 1 General provisions and Buildings’
4. https://lecturenotes.in › Subjects › Structural Dynamics
5. https://www.academia.edu › STRUCTURAL_DYNAMICS-GR_VTU_NOT.
6. https://www.studocu.com › ... › Structural Dynamics

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE - VI (PE – VI)

U18PECE061	RAILWAY ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Transportation Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: The purpose of this course is to provide knowledge on components, geometric design, amenities and modern trends in the railway system. Also to learn about modern methods of track maintenance, rehabilitation and renewal of track.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To understand the importance of railways.	U
CO2	To know about railway components.	R
CO3	To know about geometric design.	U & C
CO4	To know about the amenities of rail track.	U
CO5	To know about track maintenance.	U
CO6	To get knowledge in signaling and interlocking facilities.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2				2			3			2		3
	CO2	3	2		2			2				3		2	2
	CO3		2				2			3			2		3
	CO4	2		2					3		2			3	2
	CO5		2				3			3			2		3
	CO6	2	2		2							2		1	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

UNIT I INTRODUCTION TO RAILWAY 9

Role of railway in transportation- historical development of railways in India classification in Indian railways-technical terms used in railway engineering-the permanent way-sub grade and

embankments- ballast- sleepers.

UNIT II COMPONENTS OF RAILWAY TRACK 9

Rail- rail joints and welding of rails-track fittings and fastenings- coning of wheels - stresses in railway track- creep of rails-track alignment- surveying.

UNIT III GEOMETRIC DESIGN 9

Necessity of geometric design of railway track-gradient and grade compensation speed of train-radius of curvature-super elevation-curves-realignment of curves by string line method-widening of gauge on curves.

UNIT IV AMENITIES OF RAILWAY TRACK 9

Points and crossing- track junctions-stations and yards-equipment in station yards- signaling and control systems-interlocking of signals-construction of track

UNIT V MODERN TRENDS IN RAILWAYS 9

Track drainage-conventional maintenance of track-modern methods track maintenance-underground railwaysand tunneling-safety in railways- signaling and interlocking facilities – high speed trains - modern development in railways.

TEXT BOOKS:

1. Rangwala.P.S, "Railway Engineering", Charotar Publishing House, 26th Editions 2016.
2. Saxena Subhash, C. and Satyapal Arora,"Course in Railway Engineering", Dhanpat Rai and Sons, Delhi, 2010.
3. Agarwal.M.M, "Indian Railway Track", New Delhi.2010
4. Arora .S.P & Saxena .S.C, "A Textbook of Railway Engineering", Dhanpat Rai & Sons, 2005.

REFERENCES:

1. Satish Chandra & Agarwal .M.M, "Railway Engineering" Prabha &Co, Delhi, 2013.
2. Rangwala .S.C, revised by Rangwala .K.R & Rangwala .P.S, "Railway Engineering", Charotar Publishing House Pvt. Limited, 2th Editions, 2012.
3. Profillidis.V.A, "Railway Engineering" first published 2th Editions, 2009.
4. https://drive.google.com/file/d/1fyG5t25i2CN0wHOXlX6kNjBG4mvX7nc7/view
5. https://easyengineering.net/gps-for-land-surveyors-by-jan-van-sickle/

Course Coordinator **HOD**

U18PECE062	**CONSTRUCTION PROJECT PLANNING & SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Estimation & Costing				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To study and understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about Stages of project planning andprocess of development of plans and schedules.	U
CO2	To know about the Techniques of planning like CPM and PERT.	U
CO3	To learn the Control & monitoring of Construction methods.	U

CO4	To understand the basic concepts of planning and organizing.	U
CO5	To understand the Basics of Modern Project management systems.	U
CO6	Tounderstand the Automation & Robotics in Construction.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3					3			3		3			3
	CO2			3				3						3	
	CO3	2	1			2			2		3				2
	CO4											2			
	CO5	2	2				2			3			2		3
	CO6			2					3		2			3	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I CONSTRUCTION PLANNING 9

Definition of Projects; Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data.

UNIT II SCHEDULING PROCEDURES AND TECHNIQUES 9

Techniques of planning- basic terminology, types of precedence relationships, preparation of CPM networks, computation of float values, critical and semi critical paths, calendaring networks.PERTAssumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. Allocation of Resources.

UNIT III COST CONTROL MONITORING AND ACCOUNTING 9

Control & monitoring; Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction, Importance of Contracts Management;

UNIT IV ORGANIZATION AND USE OF PROJECT INFORMATION 9

Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves.

UNIT V QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9

Supervision, record keeping, periodic progress reports, periodical progress meetings. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

TEXT BOOKS:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

REFERENCES:

1. Project Scheduling and Management for ConstructionRevised Third Edition by David R. Pierce, Jr, 2004.
2. Construction Project Planning and Scheduling, Charles Patrick, 2003.
3. https://easyengineering.net/construction-management-by-jason-g-smith/
4. https://nptel.ac.in/content/storage2/courses/105103093/modules/partiv/testi/slides/slides1.htm

Course Coordinator **HOD**

U18PECE063	**ENVIRONMENTAL IMPACT ASSESSMNET AND LIFE CYCLE ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To educate the students on the scope, steps involved and various methods related to assessment of environmental impact due to development projects.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk.	U & R
CO2	To understand To Software packages for EIA-Expert systems in EIA.	U
CO3	To understand the concept of prediction, assessment of impacts and reporting of Environmental Management Systems	U
CO4	To study the Environmental Management Plan-preparation, implementation and monitoring programmes	Am
CO5	To know about the Cost Benefit Analysis; Life Cycle Assessment and Hydroelectric-Nuclear Power.	An
CO6	To understand the Quality aspects of Environmental Impact Assessment.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2					2		2			2			2
	CO2			2							2			1	
	CO3	2	2				2			3			2		3
	CO4	2		2					3		2			3	2
	CO5		2				2			3			2		3
	CO6	2	2		2		2					2		2	2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk.

UNIT II COMPONENTS AND METHODS 9

Components of EIA – Processes – screening – scoping – setting – analysis - mitigation. Matrices-Networks –Checklists – connections and combinations of processes – Cost benefit analysis - Analysis of alternatives - Software packages for EIA-Expert systems in EIA.

UNITIII PREDICTION, ASSESSMENT OF IMPACTS AND REPORTING 9

Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities. Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental Management Plan-preparation, implementation and review- Mitigation and Rehabilitation Plans-Policy and guidelines for planning and monitoring programmes - post project audit-Ethical and Quality aspects of Environmental Impact Assessment.

UNIT V LIFE CYCLE ASSESEMENT CASE STUDIES 9

Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational ControlCase studies related to the following sectors-Infrastructure-Mining-industrial-Thermal Power –River valley and Hydroelectric-Nuclear Power.

TEXT BOOKS:

1. Lawrence, D.P., Environmental Impact Assessment - Practical Solutions to Recurrent Problems, Wiley- Interscience, New Jersey, 2003.
2. Environmental Life Cycle Assessment, Olivier Jolliet, Myriam Saade Sbeih, Shanna Shaked, CRC Group, Tayler and Francis Group, 2015

3.Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science

London,2009

REFERENCES:

1. Canter, L.W., Environmental Impact Assessment , McGraw- Hill, New York,1996.
2. Biswas, A.K. and Agarwala, S.B.C. Environmental Impact Assessment for Developing Countries, Butterworth Heinemann, London,1994
3. Environmental Impact Assessment: A Comparative Review, Christopher Wood, Routledge 2014.
4. https://www.degruyter.com/downloadpdf/j/manment.2017.22.issue-1/manment-2018-0010/manment-2018-0010.pdf
5. https://www.environment.gov.za/sites/default/files/docs/series9_lifecycle_assessment.pdf

Course Coordinator **HOD**

U18PECE064	**BASICS OF COMPUTATIONAL HYDRAULICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydraulic Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: The main emphasis of the course is on understanding how the methods of finite differences is applied to solve unsteady free surface flow and transport equations.To understand the basics of computational fluid dynamics(CFD).

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To understand the equations describing flow and transport processes in free surface flows	U & An
CO2	To be able to understand the methods of characteristics, finite differences, finite elements, and finite volumes	U
CO3	To understand the application of the method of finite differences to ordinary and partial differential equations	U & Ap
CO4	To analyse the convergence, stability, and accuracy of numerical schemes	An
CO5	To understand three dimensional turbulent floe modeling using CFD	U
CO6	To understand the Finite difference methods applied to steady state and transient flow problems.	U & C

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				2			3		3		2		
	CO2	2		3			3					2		3	2
	CO3		2		1				2		2				
	CO4	2	2			2	2			3			2		3
	CO5	2		2					3		2			3	2
	CO6		2				2			3			2		3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 INTRODUCTION TO EULER MODELS 9

Eulerian and Lagrangian models. Classification of partial differential equations, Types of differential equations governing flow - Laplace Equation for irrotational flow, diffusion equation in groundwater flow, St.Venant's equations for one-dimensional flow in channels, modified Navier-Stokes equations for two-dimensional flow problems, .

UNIT II INTRODUCTION TO ODE AND FINITE VOLUME METHODS 9

Numerical techniques to solve ordinary differential equations, overview of solution techniques for partial differential equations - finite difference, finite element and finite volume methods - Finite difference methods applied to steady state and transient flow problems – formulation and solution.

UNIT III FINITE ELEMENT METHODS 9

Basics of FEM, different formulations, variational, weighted residual and Galerkin methods, appropriateness of these formulations to different problems, domain discretisation - different types of elements, integral equations for element matrices, derivations of boundary conditions, sources and sinks, finite difference in time domain, matrix equations, solution techniques, examples.

UNIT IV HYDRAULIC MODELS 9

Solution of the advection-dispersion equation for solute transport by Eulerian and Lagrangian methods.Models for flow routing in reservoirs and channels. Models of coastal circulation and sediment transport.

UNIT V INTRODUCTION TO CFD 9

Computational Fluid Dynamics (CFD) software for three-dimensional turbulent flow modeling, Software for sub-surface flow simulation

TEXT BOOKS

1. ChunmiaoZheng and Gordon. D. Bennett,Applied Contaminant Transport Modeling, Van NostrandReinhold.1995
2. VenTeChow,Applied Hydrology, Tata McGraw Hill Education Pvt. Ltd. 2010
3. Christopher. G. Koutitas, Mathematical Models in Coastal Engineering, Pentech Press.1988
4. S. N. Ghosh, Tidal Hydraulic Engineering, Oxford and IBH Pub. Co. Pvt. Ltd.
5. S. C. Chapra, Surface Water Quality Modeling, McGraw Hill, Inc. 2008

REFERENCES

1. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press. 2002K. Rastogi, Numerical Groundwater Hydrology, Penram International Publishing (India) Pvt. Ltd. 2012
2. VedatBatu, Applied Flow and Solute Transport Modeling in Aquifers, Taylor and Franics.2005
3. S. S. Rao, The Finite Element Method in Engineering, Elsevier.2010

4. J. N. Reddy and D. K. Garling, Finite Element Method in Heat Transfer and Fluid Mechanics, CRC Press.
5. O. C. Zienkiewicz and K. Morgan, Finite Elements and Approximations, John Wiley and Sons,1983.
6. https://www.elsevier.com/books/computational-hydraulics/brebbia/978-0-408-01153-2
7. https://www.researchgate.net/publication/290370515_Computational_Hydraulics_Numerical_Methods_and_Modelling

Course Coordinator **HOD**

U18PECE065	**RIVER ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydrology and Water Resources Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To understand theoretical concepts of water and sediment movements in rivers.To inculcate the benefits of fluvial system to the society.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	The students will be able to appreciate the complex behavior of rivers	Ap
CO2	They will gain the skills to take up research activities in river engineering.	E
CO3	To understand about river mechanics	U
CO4	To gain knowledge about river surveys	Ap
CO5	To be able to understand management of rivers	U
CO6	To learn Water Quality and ecological model.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1											2		3	
	CO2	2	2			2	2			3			2		3
	CO3	2		2				1	3		2			3	2
	CO4		2				2			3			2		3
	CO5	3			3			1			3			2	
	CO6		3				3			2			2		2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I RIVER FUNCTIONS 8

Primary function of a river – River uses and measures – Water and Sediment loads of river –

Rivers in India, Himalaya and Peninsular.

UNIT II RIVER HYDRAULICS 10

Physical Properties and Equations – Steady flow in rivers – uniform and non uniform – Turbulence and velocity profiles – resistance coefficients – Boundary conditions and back waters – Transitions – Rating Curve – Unsteady flow in rivers : Propagative of surface waves – Characteristics, flood waves – kinematic and diffusion analogy – velocity of propagation of flood waves – Flood wave –Maximum

UNIT III RIVER MECHANICS 9

River Equilibrium : Stability of Channel – regime relations – river bend equilibrium – hydraulic geometry of downstream - Bars and meandering - River dynamics – degradation and aggradations of river bed – Confluences and branches – River Data base.

UNIT IV RIVER SURVEYS AND MODEL 9

Mapping – Stage and Discharge Measurements – Sediments – Bed and suspended load Physical hydraulic Similitude – Rigid and mobile bed – Mathematical – Finite one dimensional – multi – dimensional – Water Quality and ecological model

UNIT V RIVER MANAGEMENT 9

River training works and river regulation works – -Diversion and Coffer dams-Flood plain management – waves and tides in Estuaries - Interlinking of rivers – River Stabilization-Dredging and disposal-River restoration

TEXT BOOKS

1 Janson PL.Ph., Lvan BendegamJvanden Berg, Mdevries A. Zanen (Editors), Principles of River Engineering – The non tidal alluvial rivers – Pitman, 2002.

REFERENCES

1. Pierre Y. Julien ., River Mechanics ,Cambridge University Press, 2002.
2. Rao K.L , INDIA's WATER WEALTH – Orient Longman Ltd., 1979
3. https://johndfenton.com/Lectures/RiverEngineering/River-Engineering.pdf
4. https://civilenggforall.com/irrigation-and-water-resources-engineering-textbook-free-download-pdf

Course Coordinator HOD

U18PECE066	**ENGINEERING MATERIALS FOR SUSTAINABILITY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Building Materials & Testing Methods				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To introduce various sustainable materials like recyclable materials, natural materials in the construction field and study the efficient utilization of the materials.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To learn about sustainable construction materials.	U
CO2	To learn about the life cycle assessment of the material	R
CO3	To understand about the application of recyclable materials	U
CO4	To learn about the application of natural materials in construction field	R

CO5	To learn about the production of green construction materials	R
CO6	To learn Statistical Analysis of Environmental Data.	U & An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2		2				1	3		2			3	2
	CO2		2				2			3			2		3
	CO3	3			3			1			3			2	
	CO4	3				2				3		2		3	
	CO5		2					2			3				3
	CO6	1	1						1				2	2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I **9**

An Introduction to Sustainability Concepts and Life Cycle Analysis(LCA) - Introduction, Material flow and waste management - Risk and Life Cycle Framework for Sustainability.

UNIT II **9**

Engineering Materials for Sustainability. Environmental impact of materials - life-cycle assessment - Material selection to optimize performance - Design, evaluation, and production of green construction materials.

UNIT III **9**

Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools).

UNIT IV **9**

Design for Sustainability - Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis.

UNIT V **9**

Case Studies: Odour removal for organics treatment plant, Comparison of hand drying methods, Biofuels for transportation, etc.

TEXT BOOKS:

1. SC Sharma ,"Environmental Studies" , Khanna Publishing House,2017.

2. V. Sivasubramanian, "Environmental Sustainability Using Green Technologies" CRC Press, 2016.
3. Annie R.Pearce,YongYong Han Ahn &Hanmiglobal,"Sustainable Buildings and Infrastructure", Paperback,2012.

REFERENCES:

1. Charles J. Kibert,"Sustainable Construction: Green Building Design & Delivery", John Wiley & Sons, 2016.
2. Kauffman, Joanne,Lee,Kun- Mo," Handbook of Sustainable Engineering", Springer link, 2013.
3. T. Allen David R. Shonnard, "Sustainable Engineering Concepts, Design and case Studies", Pearson, 2015.
4. Dhir Obe Ravindra K., "Sustainable Construction Materials", Elsevier Science, 2016.
5. https://www.taylorfrancis.com/books/9781315368665
6. https://civilenggforall.com/building-materials-and-construction-textbook-by-civilenggforall-free-download-pdf/

Course Coordinator **HOD**

U18PECE067	OFFSHORE ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Introduction to Fluid mechanics				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: The student will get understanding of oil and gas field development, deep waterchallenges, riser systems, platform types, remote operated vessels, Mooring lines -Typical mooring, configuration, material and construction, anchors and ancillary equipment, static mooring analysis, etc.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understand the various offshore structures and deep water challenges	U
CO2	Understand the different riser systems	U
CO3	Understand the anchors and static mooring analysis	U
CO4	Understand the vertex induced vibration	U
CO5	Understand the various remotely operated vehicles for navigation and control	U
CO6	To get knowledge on Oil and gas field development Options.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				2				3		2		3	
	CO2		2					2			3				3
	CO3	1	1						1				2	2	
	CO4	2		1				2			3			3	2
	CO5	2				2				1	3			3	
	CO6		2				1		3			1			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I: INTRODUCTION OF OIL AND GAS FIELD **9**

Introduction to offshore structures; Oil and gas field development Options: Platform types, marine riser systems, current design trends anddeep-water challenges.

UNIT II: RISER SYSTEMS **9**

Flexible pipe structure and material, typical configurations, top tensioned vertical risers, hybrid risers.Flow assurance: multi-phase flow, deposition of solids, thermal management, corrosion. Riser analysis:governing equations, boundary conditions, natural frequency.

UNIT III: MOORING SYSTEM **9**

Mooring lines -Typical mooring configuration, material and construction, anchors and ancillary equipment,static mooring analysis.

UNIT IV: VORTEX INDUCED VIBRATION **9**

Vortex induced vibration: drag, vortex shedding, surface roughness, lift, Strouhal number, VIVassessment, fatigue life calculation.

UNIT V: REMOTELY OPERATED VEHICLES **9**

Remotely operated vehicles: ROV categories- Micro, mini, general, Light work class, Heavy work class,AVUs ROV-handling systems, construction and materials, navigation and control, ,

TEXT BOOKS

1. BC Grewick, Jr. Construction of marine and offshore structure, CRC Press, 2000.
2. RD Blevins, Flow induced vibrations, Van Nostrand Reinhold, 1990.
3. N Barltrop, Floating structures: A Guide for design and analysis, OPL, 1998.

REFERENCE BOOKS

1. EE Allimendinger, Submersible vehicle systems design. SNAME, 1990.
2. HO Bordeaux, Buoy engineering, John Wiley, 1975.
3. https://epdf.pub/introduction-to-marine-engineering-second edition1a8452aa51cb93b48a3d4458470f33c760674.html
4. https://www.sanfoundry.com/best-reference-books-introduction-offshore-engineering/

Course Coordinator **HOD**

U18PECE068	**MASONRY STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Structural Analysis I				
	Course Coordinator Name & Department:				
COURSE OBJECTIVES: To make the students get familiar about the clay and concrete masonry materials, unreinforced masonry design, reinforced masonry design and masonry structural components.					
COURSE OUTCOMES (COs):					**Revised**

		Bloom's Taxonomy
CO1	To study about the basic masonry materials, including clay brick, concrete block, mortar, grout, and reinforcing accessories.	U
CO2	To analyze and design unreinforced masonry structures in compression	An
CO3	To understand the behavior of reinforced masonry structures, and be able to design for flexure, shear, axial forces, combined flexure and axial forces	U
CO4	To study about the design of load bearing masonry buildings using BIS code	C
CO5	To know the seismic behavior and design of earthquake resistant masonry buildings	U & C
CO6	To learn procedures for evaluating flexural and shear strength. Permissible stresses.	U & E

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3					3			1	3
	CO2		3						3				3		
	CO3	2		2			2			2		2			2
	CO4	3			3			1			3		1	2	
	CO5	3				2				3		2		3	
	CO6		2				1	2			3				3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT –I INTRODUCTION 9

Introduction to analysis, design and construction of masonry structures, Mechanical properties of clay and concrete masonry units, mortar, and grout.

UNIT -II STRENGTH OF MASONRY IN COMPRESSION: 9

Compressive, tensile, flexural, and shear behavior of masonry structural components, Strength and behavior of unreinforced bearing walls - Behaviour of Masonry under compression.

UNIT -III FLEXURAL SHEAR AND BOND 9

Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength. Permissible stresses:

UNIT -IV DESIGN OF LOAD BEARING MASONRY BUILDINGS 10

Design of load bearing masonry for buildings up to 3 to 8 storey's using BIS codal provisions. Detailed design of reinforced masonry beams, columns, structural walls with and without openingsand complete lateral-force resisting building systems.

UNIT -V EARTHQUAKE RESISTANT MASONRY BUILDINGS 8

Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions.

TEXT BOOKS:

1. Dayaratnam P, "Brick and Reinforced Brick Structures", Prentice Hall India Learning Private Limited, 2017.
2. Sinha B.P & Davis S.R., "Design of Masonry structures"- E & FN Spon, 2004.
3. K.S.Jagadish, "Structural Masonry", Prentice Hall India Learning Private Limited, 2015

REFERENCES:

1.Maurizio Angelillo, "Mechanics ofMasonry Structures", CISM 2014

2.Clement C.Williams, "The Design of Masonry Structures and Foundations", FB Publishers,2018.

3.https://masonrysociety.org/product/masonry-structures-behavior-and-design-4th-edition-download-version/

4.https://www.crcpress.com/Design-of-Masonry-Structures/Hendry-Sinha-Davies/p/book/9780419215608

Course Coordinator HOD

PROFESSIONAL ELECTIVE - VII (PE – VII)

U18PECE071	AIRPORT PLANNING & DESIGN	L	T	P	C
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: Students would have understood the basics of air route Planning, Network revenue Management. To know about the geometric design of the airfield. Determine runway capacity and delay. Also gain knowledge in designs of air freight terminals, airport access and landside planning.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To get ideas about airport planning.	U
CO2	To understand the environmental and social issues.	U
CO3	To know about the components of airport.	U
CO4	To get ideas about air route network.	Ap
CO5	To understand the concepts of scheduling and fleet assignment.	U
CO6	To understand Airline Fleet Planning Models.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3			3			1			3		1	2	2
	CO2	3				2				3		2		3	
	CO3		2				1	2			3				3
	CO4	2							1			3			
	CO5		2					2		3			2	3	2
	CO6				2							3			

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)

4	Approval	Meeting of Academic Council, May 2018

UNIT I AIRPORT PLANNING 9

Airport – Accessibility – Transport Connections – Road and Rail, Expansion – Feasibility Studies – Environmental and Social Issues – Forecasting Future Traffic – Airfield Capacity and Delay - Aircraft characteristics – Airport Site Selection

UNIT II AIRPORT COMPONENTS 9

Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hanger, Passenger Terminals, drainage, cargo terminals. Air traffic control – surveillance facilities.

UNIT III AIR ROUTE PLANNING AND EVALUATION 9

Demand driven dispatch – Airline Fleet Planning Models – Network Revenue Management – Airport Performance, Slot Issues, Hub Operation, Demand Management, Multi-airport Systems

UNIT IV PASSENGER CHOICE, SCHEDULING AND FLEET ASSIGNMENT 9

Load Factor Analysis, Airline Schedule Development, Introduction to PODS Passenger Choice Models, Decision Window Model, Fleet Assignment

UNIT V AIRLINE ECONOMICS 9

Pricing – Privatization and Deregulation, Willingness to pay and Competitive Revenue Management – Case study on air traffic management and navigational aids.

TEXTBOOKS:

1. S.K.Khanna and M.G.Arora, "Airport Planning and Design", Sixth Edition 2012.
2. Young, S. B., and Wells, A. T. Airport Planning and Management, Sixth Edition, McGraw-Hill, New York, USA, 2011
3. Robert Honjeff, Francis X.Mckelvey, William J Sproule, and Seth Young "Planning and Design of Airports", Fifth Edition, McGraw Hill, New York, 2010.
4. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York, 2003.

REFERENCE:

1. Norman J. Ashford, Saleh Mumayiz, Paul H. Wright; Airport Engineering Planning, Design, and Development of 21st century Airports, John Wiley & Sons, Inc.,2011
2. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. Planning and Design of Airports, Fifth Edition, McGraw-Hill, New York, USA, 2010.
3. Geoffrey D. Gosling; Airport ground access mode choice models, Transportation Research Board, Washington, D.C., 2008
4. Vazirani.V.N. and Chandola.S.P., Transportation Engineering-Vol.1, Khanna Technical Publications, New Delhi, 1991.
5. https://easyengineering.net/airport-engineering-planning-design-and/
6. https://soaneemrana.org/AIRPORT%20PLANNING%20AND%20MANAGEMENT%20BY%20SETH%20B.%20YOUNG%20&%20ALEXANDER%20T.%20WELLS1.pdf

Course Coordinator **HOD**

U18PECE072	**CONTRACTS MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Estimation & Costing				

	Course Coordinator Name & Department:

COURSE OBJECTIVES: To study the various types of construction contracts and their legal aspects and provisions.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know about the Activities in Contract Management.	U & R
CO2	To know about the types of Contracts and Formulation of Contract.	U & R
CO3	To study about Performance parameters in contracts.	U & R
CO4	To learn aboutthe various Acts governing Contracts.	U & R
CO5	To know about Legal Aspects in Contract Management.	U & R
CO6	To understand Contract Management in Consultancy.	U & R

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2		2				1	3		2			3	2
	CO2		2				2			3			2		3
	CO3	3			3			1			3			2	
	CO4	3				2				3		2		3	
	CO5		2					2			3				3
	CO6	1	1						1				2	2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION 9

Contract Management – Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People-Resource Management;

UNIT II CONSTRUCTION CONTRACT 9

Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.

UNIT III CONTRACT PROCESS 9

Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods.

UNIT IV CONTRACT ACTS 9

Various Acts governing Contracts; Contract Administration and Payments- Contract

Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of GoodsDesign, Supply and Installation Contracts, Contract Management in Consultancy,;

UNIT V CONTRACT MANAGEMENT 9

Managing Risks and Change- Managing Risks, Managing Change; Contract Closure and ReviewEnding a Contract, Post-Implementation Review; Legal Aspects in Contract ManagementContract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement.

TEXT BOOKS:

1. Introduction to Construction Contract Management, by Brian Greenhalgh, 2016.
2. Jimmie Hinze, "Construction Contracts ", 2nd Edition, McGraw Hill, 2001.
3. Fundamentals of Building Contract Management, Philip Davenport and Thomas E. Uher, 2002.

REFERENCES:

1. Joseph T. Bockrath, " Contracts and the Legal Environment for Engineers and Architects", 6th Edition, McGraw Hill, 2000.
2. Richard Hudson Clough, Glenn A. Sears, "Construction Contracting", J. Wiley, 21-Mar-2005.
3. http://www.ncc.org.zm/wp-content/uploads/2016/02/003-Training-Manual-Introduction-to-Contract-Management-and-Administration.pdf
4. https://www.cips.org/documents/CIPS_KI_Contract%20Management%20Guidev2.pdf

Course Coordinator **HOD**

U18PECE073	**ENVIRONMENTAL LAW AND POLICY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To educate Environment governance, Sustainable development, Carbon credit and foot print. To understand right to Environment as Human right, Humanitarian law and Environment.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To know the concept of laws and environmental laws and policies,.	U
CO2	To understand about the Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print	U
CO3	To understand in detail law pertaining to utilization of water and control effluent discharge	U
CO4	To know about the control of pollution. as amended by Amendment Act	R
CO5	To know about the Relevant notifications in connection with Hazardous Wastes	R
CO6	To get knowledge on Famous international protocols like Kyoto.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2

2	CO1	2							2				3		2
	CO2		2			2					2				
	CO3	1			3					3		2		2	
	CO4		2	1			1	2			3				3
	CO5	2							1			3			
	CO6		2		2			2		3			2	3	2
3	Category	Humanities & Social Sciences including Management Courses (HS)		Basic Sciences (BS)		Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**		Open Elective (OE)	Massive Open Online Course(MOOC)		Employment Enhancement Courses (EEC)		Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018													

UNIT I INTRODUCTIONTO ENVIRONMENTAL LAW 9

Overview of environment, nature and eco system, Concept of laws and policies, origin of environmental law, Introduction to environmental laws and policies,

UNIT II SUSTAINABLEDEVELOPMENT 9

Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc.,

UNITIII INTRODUCTION TO TRADE AND ENVIRONMENT 9

Introduction to trade and environment. International environmental laws, Right to Environment as Human Right,International Humanitarian Law and Environment, environment and conflicts management,Famous international protocols like Kyoto.

UNITIV WATERACT 9

Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention and control of pollution) Rules 1975 Water (prevention & control or Pollution) Cess Act. 1977 as amended by Amendment Act 1987 and relevant notifications.

UNITV HAZARDOUSWASTEREGULATION 9

Relevant notifications in connection with Hazardous Wastes (management and handling) Biomedical wastes (management and handling), Noise pollution, Eco- labelling.

TEXT BOOKS:

1 VenketEnvironmental Law and Policy rentice Hall India Learning Private Limited (2011)

2. Pandey J.N., "Constitutional Law of India", (31st Edn.) Central Law Agency Allahabad2007.

3. Kesari U.P.D., "Administrative Law 12008", Universal Book TradeDelhi.

4. Constitution of India", Eastern Book Company Lucknow, 12thEdn.2007.

REFERENCES

1. Environmental Law, S C Shastri, Eastern Book Co (2017)

2. Tiwari H.N., "Environmental Law", Allahabad Law Agency2007.

3. Divan A., and Noble M., "Environmental Law and Policy in India (cases, Materials and Statutes)",Tripathi Bombay,2001.

4. "Environmental Policy, Forest Policy", Bare Acts - Government Gazette Notifiaciton.

5.https://cdem.somaiya.edu/media/pdf/Env%20Law%20and%20policy%20.pdf

6.https://wedocs.unep.org/bitstream/handle/20.500.11822/21491/MEA-handbook-Vietnam.pdf?sequence=1&isAllowed=y

Course Coordinator **HOD**

U18PECE074	**HYDRAULIC MODELING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Hydraulic Engineering				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: The objective of the course is to provide a physical understanding of phenomena and concepts in advanced water flows and to introduce calculation methods to analyze a number of important hydraulic problems.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Possess a solid understanding of the basic phenomena and processes that govern free-surface flows	U & An
CO2	Be able to formulate advanced models based on the governing equations for free-surface flows and to solve the equations for commonly encountered flow situations	E
CO3	Be able to analyze complex flow problems using dimensional analysis and to develop rules for experiments with scale models	An
CO4	To understand the impact of flowing water on submerged bodies and structures	U
CO5	To understand about hydraulic modelling	U
CO6	To get knowledge on Modelling of open channel systems.	Ap

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2	1			1	2			3				3
	CO2	2							1			3			
	CO3		2		2			2		3	2		2	3	2
	CO4	3													
	CO5		3			3		3			1			3	
	CO6				3							3			3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT 1 INTRODUCTION **9**

Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the

model, scale effect, design, construction, operation and interpretation of the results)

UNIT II INTRODUCTION TO PHYSICAL MODELS 9

Development of physical models – dimensional analysis and principles of similitude, nondimensional numbers employed in hydraulic modelling, tools and procedures. Role of instrumentation and data processing; Gravity dominated models (modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations);

UNIT III OPEN CHANNEL SYSTEM 9

Modelling of open channel systems, closed conduit systems and urban drainage systems.Environmental modelling of open channel systems.Gravity friction models: (pumped flow models, ship models, surge tank models); Friction dominatedmodels

UNIT IV RIVER MODELS 9

River models with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures Modelling of estuaries, coastal processes, nearshore structures, and hydraulics structures.

UNIT V HYBRID MODELS 9

Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modeling.

TEXT BOOKS

1. Pavel Novak, Vincent Guinot, Alan Jeffrey, and Dominic. E. Reeve, Hydraulic Modelling – An Introduction, Spon Press.2010
2. James. J. Sharp, Hydraulic Modelling, Butterworths2007.
3. Helmut Kobus and Gerrit Abraham, Hydraulic Modelling, Parey.1980

REFERENCES

1. S. N. Ghosh, Tidal Hydraulic Engineering, Oxford and IBH Pub. Co. Pvt. Ltd. 1986
2. VedatBatu, Applied Flow and Solute Transport Modeling in Aquifers, Taylor and Franics.2006
3. James. L. Martin and Steven. C. McCutcheon, Hydrodynamics and Transport for Water Quality Modeling, Lewis Pub.1998.
4. https://johndfenton.com/Lectures/Hydraulics/Hydraulics.pdf
5. https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12018.pdf

Course Coordinator **HOD**

U18PECE075	**WATER RESOURCE FIELD METHODS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Physico-Chemical Processes for Water and Wastewater Treatment				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To understand the basic chemistry of water, standards stream flow net analysis and the principles of ground water flow.To learn the aquifer parameters, discharge measuring structures, dilution techniques etc.Study the concept of catchment, run-off estimation, water conservation and reservoir sedimentation.

COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**

CO1	To learn about the basics of Water quality standards.	R
CO2	To learn about the Discharge and draw down for various condition of groundwater	R
CO3	To have a clear understanding about Locating hydro geological boundaries – Image well theory – Determination	U
CO4	To study the basics of Discharge Measuring Structures -	U & R
CO5	To study about various models affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph –Runoff estimation	U & E
CO6	To evaluate well loss parameters.	E

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1		2	1			1	2			3				3
	CO2	2							1			3			
	CO3		2		2			2		3	2		2	3	2
	CO4		2	1			1	2			3				3
	CO5	2							2				3		2
	CO6		2			2					2			2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT WATER QUALITY 9

Chemical composition of water - Hydrological processes and water quality – Suspended and dissolved loads - Sediments and their composition – Eutrophication and its impacts - – Water quality standards. Sources and Types of water pollution – Organic and inorganic pollutants -- BOD – DO relationships — NPS pollution – Waste water treatment - TMDL Concepts – Water quality models.

UNIT II GROUNDWATER HYDRAULICS 9

Groundwater Movement - Darcy‟s law and its limitations - Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of wells – Interference of wells

UNIT III PUMPING TEST ANALYSIS 9

Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination

UNIT IV STREAMFLOW MEASUREMENT 9

Stage and Velocity Measurement – Gauges – Current meter and Doppler flow velocity meter - Discharge measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site. **.**

UNIT V RUNOFF AND WATER CONSERVATION 9

Concept of catchment – Linear, Areal and Relief Aspects – Detailed study of Runoff process – Factors affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph –Runoff estimation - Strange and SCS methods – Water Conservation – Rain water and Runoff Harvesting in Rural and Urban Areas - Reservoir Sedimentation.

TEXT BOOKS

1. Patra.K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2008, 2nd Edition, New Delhi. 4. Jeya Rami Reddy.P, "Hydrology, Laximi Publications, New Delhi, 2004.
2. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.

REFERENCES

1. Subramanya K., "Hydrology,Tata McGraw Hill Co., New Delhi, 1994.
2.https://easyengineering.net/water-resources-hydrology-irrigation/
3.http://dl.watereng.ir/doc/Larry%20W.%20Mays%20%20Water%20Resources%20Engineering%20_2010,%20Wiley_.pdf

Course Coordinator **HOD**

U18PECE076	**BRIDGE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of Steel Structures				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To develop an understanding of appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location, functionality on various types of bridges like pre-stressed concrete bridges, steel bridges, plate girder bridge, truss bridge, suspension cable bridge, and cable stayed bridge.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To study about the various classification of bridges their geometric and hydraulic design consideration	An
CO2	To know the analyse and design of prestressed bridges	An & C
CO3	To understand the design procedure of different types of bridges.	U & C
CO4	To study about the design concepts of substructure, seismic design considerations	C
CO5	To impart the students about the concept of stability consideration, inspection and maintenance	U
CO6	To learn Aerodynamic stability considerations.	U

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3				3					3			1	3
	CO2		3						3				3		
	CO3	2		2			2			2		2			2
	CO4	3			3			1			3		1	2	
	CO5	3				2				3		2		3	
	CO6		2				1	2			3				3

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I INTRODUCTION **9**

General - classification of bridges- site selection- geometric and hydraulic design consideration,- Loading standards for highway - railway bridge

UNIT II DESIGN OF RC AND PSC BRIDGES **9**

General design consideration; optimum spans- Concrete bridges culverts- Slab- T-beam - Pre-stressed Concrete bridges

UNIT III TYPES OF BRIDGES **9**

Box girder bridges- balanced cantilever bridge - cable stayed bridge - extrados bridges - arch bridge - Special requirements for Steel bridges- plate Girder Bridge - truss bridge – Introduction to suspension Cable Bridge - cable stayed bridge

UNIT IV BRIDGE COMPONENTS

Substructures - design of piers and abutments - pile and well foundations -Bearings and expansion joints- special wearing coats - seismic design considerations

UNIT V STABILITY CONSIDERATIONS **9**

Aerodynamic stability considerations- special durability measures -provisions for inspection – maintenance.

TEXTBOOKS:

1.Design of Bridges by N.Krishnam Raju, Oxford & IBH, Publishing Company Pvt.ltd., Delhi.
2.Johnson Victor D., “Essentials of Bridge Engineering”,
3.Jagadeesh .T.R. and Jayaram.M.A., "Design of Bridge Structures".

REFERENCES:

1. Bowles .J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York,
2. Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Ltd.
3. R.Rajagopalan, "Bridge Superstructure", Tata Mcgraw- Hills Publishing Company Limited.
4. https://easyengineering.net/bridge-engineering-books/

5. http://civilcafe.weebly.com/uploads/2/8/9/8/28985467/bridge_engineering_handbook_seismic_design_second_edition.pdf

Course Coordinator **HOD**

U18PECE077	STRUCTURAL GEOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Engineering Geology				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To study of the application of deforming forces to earth materials and the structures resulting from that deformation.

	COURSE OUTCOMES (COs):	**Revised Bloom's Taxonomy**
CO1	Acquire knowledge on the geometry and type of structures present in earth	Ap
CO2	Understand the micro and macro scale deformation mechanisms	U
CO3	Understand geometrical and genetic classification of folds	U
CO4	Understand the origin of foliations and lineation	U
CO5	Understand geometrical and genetic classification of fractures and faults	U
CO6	To learn Strain ellipses of different types and their geological significance.	U & An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	2							1			3			
	CO2		2		2			2		3	2		2	3	2
	CO3	3													
	CO4	3				3					3			1	3
	CO5		3						3				3		
	CO6	2		2			2			2		2			2

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I STRUCTURE AND TOPOGRAPHY **9**

Description, classification, and origin of earth structures, Ways in which the continental crust can deform; Effects of topography on structural features, Topographic and structural maps; Importance representativefactors of the map; link scales of structure from the field, hand specimen,

UNIT II STRESS AND STRAIN IN ROCKS **9**

Concept of rock deformation: Stress and Strain in rocks, Strain ellipses of different types and

theirgeological significance, Planar and linear structures;Theoretical and meso to microscale analysis of structures developed through a linked series of lectures and practicals; Concept of dip and strike; Outcrop patterns of different structures. practical 2D strain analysis; 3D strain concepts; incremental strain,kinematics and polyphase deformations;

UNIT III FOLDS **9**

Fold morphology; fold construction and classes; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding

UNIT IV FOLIATION AND LINEATION **9**

Description and origin of foliations: axial plane cleavage and its tectonic significance
Description and origin of lineation and relationship with the major structures; current concepts in plate tectonics

UNIT V FRACTURES AND FAULTS **9**

Geometric and genetic classification of fractures and faults; Effects of faulting on the outcropsGeologic/geomorphic criteria for recognition of faults and fault plane solutions;fault evolution and section balancing; fault rock microstructures; fault and fold mechanics

TEXT BOOKS

1. Ghosh, S.K., Structural Geology: Fundamentals and Modern Developments, Elsevier; First edition

REFERENCES

1. Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley
2. Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall.
3. Park, R. G. (2004) Foundations of Structural Geology.Chapman & Hall.
4. Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.
5. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed).Cambridge University Press (For Practical)
6. Lahee F. H. (1962) Field Geology. McGraw Hill
7.http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf
8.http://www.geology.cz/projekt681900/vyukovematerialy/Krystof_Verner_Applied_structural_geology_and_tectonics.pdf

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Course Coordinator **HOD**

U18PECE078	**ECOLOGICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Environmental Sciences				
	Course Coordinator Name & Department:				

COURSE OBJECTIVES: To educate the students on the principles of ecology as applied to environmental engineering and also to understand the relationship between biotic and abiotic components.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Acquire knowledge on the geometry and type of structures present in earth	Ap
CO2	Understand the micro and macro scale deformation mechanisms	U
CO3	Understand geometrical and genetic classification of folds	U
CO4	Understand the origin of foliations and lineation	U
CO5	Understand geometrical and genetic classification of fractures and faults	U

CO6	To carry out Case studies on Integrated Ecological Engineering Systems.	An

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

	COs/POs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
2	CO1	3	2		2				3			2			3
	CO2														
	CO3	3		3			2			2	1			2	
	CO4		2					3							3
	CO5										3				
	CO6	3				3							1	2	

3	Category	Humanities & Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Engg. Sciences (ES)	Professional Core (PC)	**Professional Core Elective (PE)**	Open Elective (OE)	Massive Open Online Course(MOOC)	Employment Enhancement Courses (EEC)	Mandatory Courses (MC)
4	Approval	Meeting of Academic Council, May 2018								

UNIT I ECOLOGY&ENVIRONMENT 9

Aim, scope and applications of ecology - Development and evolution of ecosystems -Energy flow and material cycling in ecosystems - productivity in ecosystems, classification of systems - Structural and functional interactions of environmental systems - Environmental systems as energy systems

UNIT IIECOLOGICALENGINEERING. 9

Characteristics of rivers and lakes which affect the management of domestic and industrial wastewaters. chemical hazards assessment, surveillance and biomonitoring, and review of regulations governing effluents Modelling and ecotechnology - Elements of modeling - Modeling procedure - Classification of ecological models - Applications of models in ecotechnology - Ecological economics.

UNIT III STREAM ECOLOGY 9

Description of physical, chemical, and biological characteristics in streamsand rivers including an integrated treatment of the environmental factors affecting the composition and distribution of biota; emphasizes the application of ecological engineering Principles in aquatic ecosystem protection

UNIT IV APPLICATION OFECOLOGICALENGINEERING 9

Ecosanitation - Principles and operation of soil infiltration systems - Wetlands and ponds - Source separation systems - Aquacultural systems - Detritus based treatment for solid wastes - Applications of ecological engineering for marine systems.

UNIT V CASE STUDIES INECOLOGICALENGINEERING 9

Case studies of Integrated Ecological Engineering Systems and their commercial prospects.

TEXT BOOKS:

1. S.V.S.Rana Essentials of Ecology and Environmental science. PHI Learning Pvt ltd. Delhi 2013.
2. Kangas, P.C. and Kangas, P., *"Ecological Engineering: Principles andPractice",*Lewis Publishers, New York. 2003
3. William J Mitsch, Ecological Engineering and Ecosystem Restoration John Wiley & Sons, Inc.2015

REFERENCES

1. Etnier, C. and Guterstam, B., "Ecological Engineering for Wastewater Treatment", Lewis Publishers, New York.2007.
2. White, I.D., Mottershed, D.N. and Harrison, S.J., "Environmental Systems - An Introductory Text", Chapman Hall, London.2004.
3. Mitsch, J.W. and Jorgensen, S.E., "Ecological Engineering - An Introduction to Ecotechnology", John Wiley & Sons, New York.2009.
4. https://docs.google.com/document/d/149uEpqkQjENU8Ow4UyzoOpxvdLG3Hzf4jV1PgxCWFq0/edit
5. https://www.researchgate.net/publication/222565367_Design_principles_for_ecological_engineering

Course Coordinator **HOD**

OPEN ELECTIVE FROM CIVIL

U18OECE001	**METRO SYSTEMS AND ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Any course in Engineering				
	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To know about the urban transport problems, planning, construction and operation.

UNIT I INTRODUCTION **15**

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations

UNIT II MASS TRANSIT SYSTEMS **15**

Mass Transit concepts- Trip interchanges and assignments ; Urban transportation problems, Modes of masstransit- their planning, construction and operation, Case studies of existing mass transit systems ; Technical andeconomic evaluation of mass transit projects

UNIT III TRAFFIC INTEGRATION **15**

Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

TEXTBOOKS:

1. C. S. Papacostas, P. D. Prevedouros, Transportation Engineering and Planning, PHI Publication, 3rd edition,2002
2. S. Grava, Urban Transportation Systems, Mc. Graw Hill Professional, 1st Ed. 2002.

REFERENCES:

1. J.D. Fricker, & R.K. Whitford, Fundamentals of Transportation Engineering, Pearson, PH, 2004
2. V.R. Vuchic, Urban Transit Systems and Technology, John Wiley & Sons, February 2007
3. C.A. O'Flaherty, Transport Planning and Traffic Engineering, Arnold, 1997
4. J. E. Anderson, Transit Systems Theory, Lexinton Books, USA

	POLLUTION REGULATIONS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Any course in Engineering				
U18OECE002	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To know about various Act of pollution and control of pollution Acts for water, air and in general environmental protection.

UNIT I: INTRODUCTION **10**

Introduction - Introduction - Functions - Constitution - Organisational set up - Environmental Legislations - Monitoring of Industries - Procedure for Issue of Consent - Address of the Offices and Laboratories.

UNIT II: WATER (P&CP) ACT **10**

The Water (Prevention and Control of Pollution) Act, as amended in 1978 and 1988 - Standards for Discharge of Trade Effluent - Standards for Discharge of Sewage - Drinking Water – Specification (IS 10500:1991) - Tolerance Limits for Inland Surface - Waters subject to Pollution IS : 2296 – 1982 - Consent Fee Applicable under the Water (P&CP) Act - Parameters to be analyzed for the Industrial Effluent Samples - Rate of Cess on the Basis of Water Consumption - Cess Return Format

UNIT III: AIR (P&CP) ACT, **10**

The Air (Prevention and Control of Pollution) Act, as Amended in 1987 - Consent Fee applicable under the Air (P&CP) Act – National Ambient Air Quality Standards - Standards for Chlorine Emission.

UNIT IV:ENVIRONMENT (PROTECTION) ACT **15**

The Environment (Protection) Act, 1986 (No. 29 of 1986) - The Environment (Protection) Rules - Standard Prescribed under Environment (Protection) Rules,
Waste Water Generation Standards - Environmental Statement - The Bio-Medical Waste Management Rules, 2016

TEXTBOOK

1. Tamilnadu Pollution Control Board, January 2017.

	ROAD SAFETY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Any course in Engineering				
U18OECE003	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To learn about nature of road safety, management, uses of crash data, countermeasure selection and evaluation.

UNIT I: NATURE OF ROAD SAFETY **9**

Defining Road Safety - Road Safety – a Complex Field - Science-based Road Safety Research - Road Safety Demographics - Crash Contributing Factors and Interactions - Road User Decisions - Intervention Tools and Countermeasures

UNIT II: INSTITUTIONAL SETTINGS OF ROAD SAFETY MANAGEMENT **9**

The Foundation for Road Safety Management Policy - Safety Management Roles and Responsibilities - The Influence of Interest Groups - Road Safety Education Opportunities - Road Safety and Other Transportation Priorities

UNIT III: ORIGINS, CHARACTERISTICS AND USES OF CRASH DATA **9**

Using Data to Identify Safety Problem - State and Local Data Systems - Crash Data Collection - National Road Safety Databases

UNIT IV: CONTRIBUTING CRASH FACTORS, COUNTERMEASURE SELECTION, AND EVALUATION **9**

Problem Identification Using Scientific Methods - High Risk Entities - Countermeasure Identification - Countermeasure Identification - Diversity Analysis - Cost Effectiveness of Alternative Countermeasures.

UNIT V: ROAD SAFETY PROGRAM MANAGEMENT **9**

The Importance of Scientific Management Techniques - Strategies for Integrating and Amplifying Safety in the - Transportation Planning Processes - Organizational Leadership and Support Needs - Effective Multidisciplinary - Collaborative Relationships - Coalition Building Communications Strategies - Current Research Supporting Road Safety Management - Stimulating Change - Funding Sources and Requirements -Leveraging Resources - Outreach and Public Involvement

U18OECE004	**INFRASTRUCTURE DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Any course in Engineering				
	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To know about infrastructure development related to sanitation, storm water, municipal wastes, power and fire.

UNIT I: ROLE OF INFRASTRUCTURE IN DEVELOPMENT **10**

Elements of Infrastructure (physical, social, utilities and services); Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, provision of infrastructure, and land requirements; Principles of resource distribution in space; Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards.

UNIT II: PLANNING AND MANAGEMENT OF WATER, SANITATION AND STORM WATER **10**

Water – sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues; Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, DEWATS, institutional arrangements, planning provisions and management issues. Storm water – rainfall data interpretation, points of water stagnation, system of natural drains, surface topography and soil characteristics, ground water replenishment, storm water collection and disposal, norms and standards, institutional arrangements, planning provisions and management issues;

UNIT III: PLANNING AND MANAGEMENT OF MUNICIPAL WASTES, POWER AND FIRE 10

Municipal and other wastes – generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms and standards, institutional arrangements, planning provisions and management issues. Power – Sources of power procurement, distribution networks, demand assessment, norms and standards, planning provisions and management issues. Fire – History of fire hazards, vulnerable locations, methods of fire fighting, norms and standards, planning provisions and management issues.

UNIT IV: TRANSPORT INFRASTRUCTURE PLANNING, MANAGEMENT AND DESIGN 15

Role of transport, types of transport systems, evolution of transport modes, transport problems and mobility issues**;** Urban form and Transport patterns, land use – transport cycle, concept of accessibility; Hierarchy, capacity and geometric design elements of roads and intersections**;** Basic principles of Transport infrastructure design; Traffic and transportation surveys and studies, traffic and travel characteristics; Urban transport planning process – stages, study area, zoning, data base, concept of trip generation Transport, environment and safety issues; principles and approaches of traffic management, transport system management.

TEXTBOOKS:

1. Crisis in road transport Konark Publishers Pvt. Ltd. , Mohinder Sing and L.R. Kadiyali, New Delhi, 1989
2. Traffic engineering and transportation planning, L. R. Kadiyali, Khanna Publishers, New Delhi, 2007.

REFERENCES:

1. Environmental scenario inIndia, Mukerjee S. and Chakraborty D. (Eds), Routledge, London, 2012.
2. Infrastructure and Governance , Sameer Kochhar, Deepak B. Phatak, H. Krishnamurthy, Gursharan Dhanjal, (eds), Academic Foundation, New Delhi, 2008.

	PROJECT SAFETY MANAGEMENT	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Any course in Engineering				
U18OECE005	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To study relationship between Projects and Planning at various Levels. To study Management, Implementation and Evaluation of Projects.

UNIT I:PROJECT PLANNING **10**

Introduction to Projects; Nature of planning projects; Project Life Cycle; Identification of projects

UNIT II: PROJECT FORMULATION AND APPRAISAL **10**

Relationship between projects and planning issues including sectoral policy at: Local, State and National levels Project appraisal: Market analysis – Macro environment survey, survey methods, market characterization, demand forecasting; Technical Analysis – Magnitude, processes, materials, equipment, factors of production availability, implementation schedule; suitability of the plans, layout and design, location of the project; location analysis; supporting infrastructurerequirements- Capital Budgeting – Estimation of costing of components; developing over project cost; Social cost benefit analysis – UNIDO, Merles, ZOPP/GOPP, etc.

UNIT III: PROJECT MANAGEMENT AND IMPLEMENTATION, AND PROJECT EVALUATION AND MONITORING **10**

Project characteristics - pitfalls in management of a project; Techniques of management; Planning milestones - responsibility charts and principle responsibility, principles of activity planning; Project Implementation – methods, hurdles, facilitative factors; Project culture: line management, steering committee, role of project manager; Project Control: cost and time, quality - ISI standards and its application to Indian context; Introduction to Project Management Software (Ms Projects) and its usage. Types of evaluation - concurrent, ex-ante and ex-post. Methods of evaluation, techniques of evaluation, end results, Presentation of evaluation findings, Techniques of Monitoring of Development Works.

UNIT IV: REGULATORY FRAMEWORKS GOVERNING PROJECTS **15**

National Rehabilitation and Resettlement Policy (2007) - Social Impact mitigation; National Environmental Policy (2006) – Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP).

TEXTBOOKS:

1. Projects reports, Prasanna Chandra McGraw Hill, New Delhi, 2009.
2. Brilliant Project Management, Barker, Stephenand Cole, Rob. Pearson Education Limited, UK, 2007.

U18OECE006	**ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Any course in Engineering				
	Course Designed by – Dept of Civil Engineering				
	Category – OPEN ELECTIVE (OE)				
	Approval - Meeting of Academic Council, May 2018				

OBJECTIVES: To study about the factory safety norms, environmental policies, storage and import of hazardous chemical rules and other rules and regulations.

UNIT I: FACTORIES ACT – 1948 **9**

Stuatutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948

UNIT II ENVIRONMENT ACT – 1986 **9**

General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

UNIT III MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989 **9**

Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

UNIT IV OTHER ACTS AND RULES **9**

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act.

UNIT V INTERNATIONAL ACTS AND STANDARDS **9**

Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Helath and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

TEXTBOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

REFERENCES

1. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
2. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
4. National seminar on hazardous waste management organized by National Safety council, Ministry of environment and forests, Government of India, United States – Asia environmental partnership, Tamilnadu pollution control board and Indian chemical manufacturers association, April 2001.

CURRICULUM AND SYLLABUS – R2018

B–FACT: Bharath -**F**lexible **A**ccommodative **C**hoice Based Credit System for **T**echnology

(Applicable to the batches admitted from July 2018)

B.Tech – INFORMATION TECHNOLOGY

SEMESTER I – VIII

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	3	0	0	3
2	U18BSMA101	BS	Engineering Mathematics- I	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
6	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	2	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	2	0
8	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	3	0	0	3
9	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB203	MC	Yoga	2	0	0	2	0
11	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
Total				**37**	**20**	**1**	**12**	**23**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	3	0	0	3
2	U18BSMA201	BS	Engineering Mathematics- II	4	3	1	0	4
3	U18BSPH202	BS	Semi Conductor Physics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	3	0	0	3
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	4	2
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	4	2
9	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – NCC	2	0	0	2	0
11	U18MCAB102	MC	Yoga	2	0	0	2	0
Total				**34**	**18**	**1**	**16**	**25**

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	**U**18BSMA304	BS	Probability & Queuing Theory	4	3	1	0	4
2	U18ESIT302	ES	Principles of Communication systems	3	3	0	0	3
3	U18PCIT303	PC	Database Management Systems	3	3	0	0	3
4	U18PCIT304	PC	Data Structures and Algorithms	3	3	0	0	3
5	U18PCIT305	PC	Object Oriented Analysis and Design	3	3	0	0	3
6	U18PCIT306	PC	Computer Architecture	3	3	0	0	3
PRACTICAL								
7	U18PCIT3L1	PC	Database Management Systems Lab	3	0	0	4	2
8	U18PCIT3L2	PC	Object Oriented Programming Lab	3	0	0	4	2
9	U18PCIT3L3	PC	Data Structures lab	3	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
Total				32	18	1	16	25

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA401	BS	Discrete Mathematics	4	3	1	0	4
2	U18PCIT401	PC	Web Programming	3	3	0	0	3
3	U18PCIT402	PC	Operating System Principles	3	3	0	0	3
4	U18PCIT403	PC	Software Engineering Methodologies	3	3	0	0	3
5	U18ESIT404	ES	Digital System Design	3	3	0	0	3
6	U18PCIT405	PC	Data Communication and Computer Networks	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	0	0	2	0
PRACTICAL								
7	U18PCIT4L1	PC	Data Communication and Computer Networks Lab	3	0	0	4	2
8	U18PCIT4L2	PC	Web Programming Lab	3	0	0	4	2
9	U18PCIT4L3	PC	Operating System Design Lab	3	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
Total				34	18	1	18	25

SEMESTER V								
Sl. No.	**Code No.**	**Categ ory**	**Course Title**	**Contac t Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCIT501	PC	Data Mining	3	3	0	0	3
2	U18PCIT502	PC	Mobile Communication	3	3	0	0	3
3	U18PCIT503	PC	Principles of Artificial Intelligence	3	3	0	0	3
4	U18PCIT504	PC	Theory of computation	3	3	0	0	3
5	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
6	U18MCCH501	MC	Constitution of India	2	0	0	2	0
7	U18PEIT5E1	PE – 1	Professional Elective - I	3	3	0	0	3
PRACTICAL								
8	U18PCIT5L1	PC	Data mining Lab	3	0	0	4	2
9	U18PCIT5L2	PC	IT -Workshop Lab	3	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB509	MC	Self Development Spiritual - Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB510	MC	Self Development - religion and Inter-faith	2	0	0	2	0
Total				30	18	0	14	22

SEMESTER VI								
Sl.No.	**Code No.**	**Cate gory**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCIT601	PC	Grid and Cloud Computing	3	3	0	0	3
2	U18PCIT602	PC	Human Computer Interaction	3	3	0	0	3
3	U18PCIT603	PC	Data Analytics	3	3	0	0	3
4	U18PEIT6E2	PE	Professional Elective-II	3	3	0	0	3
5	U18PEIT6E3	PE	Professional Elective III	3	3	0	0	3
6	U18OEIT6E1	OE	Open Elective-I	3	3	0	0	3
PRACTICAL								
7	U18PCIT6L1	PC	Data Analytics Lab	3	0	0	4	2
8	U18PCIT6L2	PC	Grid and Cloud Computing Lab	3	0	0	4	2
9	U18EEIT6L3	EE	Soft skill	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB609	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB610	MC	Social Services – NSS	2	0	0	2	0
Total				30	18	0	14	23

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCIT701	PC	Wireless Networks	3	3	0	0	3
2	U18PEIT7E4	PE	Professional Elective- IV	3	3	0	0	3
3	U18PEIT7E5	PE	Professional Elective- V	3	3	0	0	3
4	U18OEIT7E2	OE	Open Elective-II	3	3	0	0	3
5	U18MCTH703	MC	Essence of Indian Knowledge Tradition	2	0	0	2	0
PRACTICAL								
6	U18PRIT7P1	PR	Project Phase-I	6	3	0	0	3
ACTIVITY BASED COURSES								
7	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
8	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
Total				24	15	0	6	15

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PEIT8E6	PE	Professional Elective- VI	3	3	0	0	3
2	U18OEIT8E3	OE	Open Elective – III	3	3	0	0	3
3	U18OEIT8E4	OE	Open Elective – IV (MOOC)	2	0	0	0	2
PRACTICAL								
4	U18PRIT8P2	PR	Project Phase-II	12	0	0	18	9
ACTIVITY BASED COURSES								
5	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total				22	6	0	20	17

Total : 175 Credits

	PROFESSIONAL ELECTIVE- I					
SUB.CODE	**SPECIALIZATION**	**SUBJECT NAME**	**L**	**T**	**P**	**C**
U18PEIT011	Image Processing	Computer Vision	3	0	0	3
U18PEIT012	Networking	Ad hoc and Sensor Networking	3	0	0	3
U18PEIT013	Soft Computing	Optimization Techniques	3	0	0	3
U18PEIT014	Data Science	Visual Analytics	3	0	0	3
U18PEIT015	Data Science	Health Informatics	3	0	0	3
U18PEIT016	Software	Software Testing	3	0	0	3
	PROFESSIONAL ELECTIVE- II					
U18PEIT021	Networking	High Speed Networks	3	0	0	3
U18PEIT022	Soft Computing	Natural Language Processing	3	0	0	3
U18PEIT023	Soft Computing	Social Network Analysis	3	0	0	3
U18PEIT024	Data Science	Business Analytics	3	0	0	3
U18PEIT025	Software	Mobile Application Development	3	0	0	3
U18PEIT026	Image Processing	Wavelet Transforms and its	3	0	0	3
	PROFESSIONAL ELECTIVE-III					
U18PEIT031	Networking	Cyber Forensics	3	0	0	3
U18PEIT032	Image Processing	Virtual and Augmented Reality	3	0	0	3
U18PEIT033	Data Science	Applications of Data Mining	3	0	0	3
U18PEIT034	Data Science	Machine Learning Techniques	3	0	0	3
U18PEIT035	Soft Computing	Bio-Inspired Computing	3	0	0	3
U18PEIT036	Software	Software configuration	3	0	0	3
	PROFESSIONAL ELECTIVE-IV					
U18PEIT041	Networking	Cloud Computing and Security	3	0	0	3
U18PEIT042	Soft Computing	Multi-agent System	3	0	0	3
U18PEIT043	Data Science	Mining Social Media	3	0	0	3
U18PEIT044	Image Processing	Medical Image Processing	3	0	0	3
U18PEIT045	Software	Agile Methodology	3	0	0	3
U18PEIT046	Image Processing	Multimedia compression	3	0	0	3
	PROFESSIONAL ELECTIVE- V					
U18PEIT051	Networking	Internet of Things	3	0	0	3
U18PEIT052	Soft Computing	Artificial Intelligent Game	3	0	0	3
U18PEIT053	Soft Computing	Inferential statistics	3	0	0	3
U18PEIT054	Image Processing	Deep Learning	3	0	0	3
U18PEIT055	Software	Software Quality	3	0	0	3
U18PEIT056	Software	Software Architecture	3	0	0	3
PROFESSIONAL ELECTIVE- VI						
U18PEIT061	Soft Computing	Quantum Computing	3	0	0	3
U18PEIT062	Data Science	Real Time Systems	3	0	0	3
U18PEIT063	Image Processing	Computer Graphics	3	0	0	3
U18PEIT064	Artificial Intelligence	Business Intelligence	3	0	0	3
U18PEIT065	Data Science	Information Theory and Coding	3	0	0	3
U18PEIT066	Artificial Intelligence	Multi agent Intelligent Systems	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial

45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS004-Mobile Application Development
72. U18OECS005-System Modelling and Simulation
73. U18OECS006-Web Programming
74. U18OECS007-Virtual Reality
75. U18OECS008- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	Communicative English	4	3	0	0	3
2	U18HSEN201	Technical English	3	3	0	0	3
3.	U18HSBA501	Organizational Behavior	3	3	0	0	3
Total Credits							**9**

LIST OF BASICS SCIENCE COURSES (BS)

Sl. No.	Course Code	Course Title	Contact Period	L	T	P	C
1	U18BSMA101	Engineering Mathematics- I	4	3	1	0	4
2	U18BSPH101	Waves and Optics	3	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	3	0	0	3
4	U18BSBT101	Biology for Engineers	2	2	0	0	2
5	U18BSPH2L2	Wave Optics and Semi Conductor Physics Lab	3	0	0	2	0
6	U18BSCH2L4	Chemistry Lab	3	0	0	2	0
7	U18BSMA201	Engineering Mathematics- II	4	3	1	0	4
	U18BSPH202	Semi Conductor Physics	3	3	0	0	3
8	U18BSCH201	Environmental Sciences	3	3	0	0	3
9	U18BSPH2L2	Wave Optics and Semi Conductor Physics Lab	3	0	0	4	2
9	U18BSCH2L4	Chemistry Lab	3	0	0	4	2
10	U18BSMA304	Probability & Queuing Theory	4	3	1	0	4
11	U18BSMA401	Discrete Mathematics	4	3	1	0	4
TOTAL CREDITS							34

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18ESEE101	Basic Electrical & Electronics Engineering	3	3	0	0	3
2	U18ESME101	Engineering Graphics & Design	5	3	0	0	3
3	U18ESCS101	Problem Solving and Python Programming	3	3	0	0	3
4	U18ESME1L2	Workshop/Manufacturing Practices Laboratory	5	3	0	0	3
5	U18ESEE1L3	Basic Electrical & Electronics Engineering Laboratory	3	0	0	4	2
6	U18ESCS1L1	Problem Solving and Python Programming Laboratory	3	0	0	4	2

7	U18ESIT302	Principles of Communication systems	3	3	0	0	3
8	U18ESIT404	Digital System Design	3	3	0	0	3
Total credits							**22**

LIST OF PROFESSIONAL CORE COURSES

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18PCIT303	Database Management Systems	3	3	0	0	3
2	U18PCIT304	Data Structures and Algorithms	3	3	0	0	3
3	U18PCIT305	Object Oriented Analysis and Design	3	3	0	0	3
4	U18PCIT306	Computer Architecture	3	3	0	0	3
5	U18PCIT3L1	Database Management Systems Lab	3	0	0	4	2
6	U18PCIT3L2	Object Oriented Programming Lab	3	0	0	4	2
7	U18PCIT3L3	Data Structures lab	3	0	0	4	2
8	U18PCIT401	Web Programming	3	3	0	0	3
9	U18PCIT402	Operating System Principles	3	3	0	0	3
10	U18PCIT403	Software Engineering Methodologies	3	3	0	0	3
11	U18PCIT405	Data Communication and Computer Networks	3	3	0	0	3
12	U18PCIT4L1	Data Communication and Computer Networks Lab	3	0	0	4	2
13	U18PCIT4L2	Web Programming Lab	3	0	0	4	2
14	U18PCIT4L3	Operating System Design Lab	3	0	0	4	2
15	U18PCIT501	Data Mining	3	3	0	0	3
16	U18PCIT502	Mobile Communication	3	3	0	0	3
17	U18PCIT503	Principles of Artificial Intelligence	3	3	0	0	3
18	U18PCIT504	Theory of Computation	3	3	0	0	3
19	U18PCIT5L1	Data mining Lab	3	0	0	4	2
20	U18PCIT5L2	IT -Workshop Lab	3	0	0	4	2
21	U18PCIT601	Grid and Cloud Computing	3	3	0	0	3
22	U18PCIT602	Human Computer Interaction	3	3	0	0	3
23	U18PCIT603	Data Analytics	3	3	0	0	3
24	U18PCIT 6L1	Data Analytics Lab	3	0	0	4	2
25	U18PCIT 6L2	Grid and Cloud Computing Lab	3	0	0	4	2
26	U18PCIT701	Wireless Networks	3	3	0	0	3
Total Credits							68

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SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences **(HS**)	3	3	-	-	3	-	-	-	9	5.14
2	Basic Sciences **(BS)**	12	14	4	4	-	-	-	-	34	19.43
3	Engineering Sciences **(ES)**	8	8	3	3	-	-	-	-	22	12.57
4	Professional Core **(PC)**	-	-	18	18	16	13	3	-	68	38.86
5	Professional Electives**(PE)**	-	-	-	-	3	6	6	3	18	10.29
6	Open Electives (**OE)**	-	-	-	-	-	3	3	5	11	6.29
7	Employability Enhancement Courses **(EE)**Project Work, Soft Skill etc.	-	-	-	-	-	1	3	9	13	7.43
	Total Credit	23	25	25	25	22	23	15	17	175	100
	Total Contact Hour	37	34	32	34	30	30	24	22	243 Hrs	-

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	0	0	3
	Prerequisite – School Level English				
	Dept Designed by: ……Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6 hours

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing one self – exchanging personal information- narrating events, -incidents , speaking about one‘s friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6 hours

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING 6 hours

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6 hours

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms-phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6 hours

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely.

SOFTSKILL LABORATORY 30

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews &conversations
4. Reading different genres of texts

5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds- intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

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COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
1							**3**	**2**	**2**	**3**		**2**			
2							**3**	**2**	**2**	**3**		**2**			
3							**3**	**2**	**2**	**3**		**2**			
4							**3**	**2**	**2**	**3**		**2**			
5							**3**	**2**	**2**	**3**		**2**			
Category	**HS**														
Approval	47th Meeting of Academic Council														

	ENGINEERING MATHEMATICS – I	L	T	P	C
U18BSMA101	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by – Department of Mathematics				
OBJECTIVES	➢ The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. ➢ It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I THEORY OF EQUATIONS (9+3)Hours

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3) Hours

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle‘s Theorem – Mean Value Theorem – Taylor‘s and Maclaurin‘s Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3) Hours

Partial derivatives –Euler‘s theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian–Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variables (9+3) Hours

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3) Hours

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas‘ Calculus ,Twelfth Edition, Addison-Wesley, Pearson.
5. Narayanan S., Manickavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for

Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3	2	2	1				2			2		2	
CO2	3	3	2	2	1				3					2	
CO3	2	3	2	2	2				2					2	
CO4	3	3	2	2	1				1					2	
CO5	2	3	2	2	1				2			2		2	
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18BSPH101	**WAVES AND OPTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

UNIT1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9 hours

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9 hours

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection

modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9 hours

Fermat‘s principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster‘s angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVES OPTICS 9 hours

Huygens‘ principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young‘s double slit experiment, Newton‘s rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9 hours

Einstein‘s theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, ―A Textbook of Engineering Physics‖ S.Chand Publishers, 2016 (for UNITs 1,3,4 & 5)
2) G.Senthil Kumar, ―Engineering Physics‖, VRB publishers, Chennai, 2015 (for UNIT 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, ―Waves and Oscillation‖, VikasPublishsing House, 2011
2) R.Murugesan,―Optics and Spectroscopy‖, S.Chand Publishers, 2015
3) BrijLal and Subramanian,―Optics‖, S.Chand Publishers 2006
4) Ian G. Main, ―Vibration and waves in physics‖, Cambridge University Press, 1978
5) H.J. Pain, ―The physics of vibrations and waves‖, 6th edition, Wiley 2006
6) AjoyGhatak, ―Optics‖, Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, ―Principles of Lasers‖, Springer, 2010
8) Online reference Wikipedia.org

COURSE OUTCOMES (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-DestructiveTesting
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3							1	2			2		2	3

CO2	3							1	2					2	
CO3	2							3	2			2		2	
CO4	3							1	2			2		2	
CO5	3							1	2			2		2	
Category	Basic Sciences (BS)														
Approval	47th Meeting of Academic Council														

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9 hours

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9 hours

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson‘s Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9 hours

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for Power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9 hours

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane

number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9 hours

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. Nano composites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, –Engineering Chemistry‖ DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara ―A text book of Engineering Chemistry‖ S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, ―Engineering Chemistry, Volume 1‖, Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES BOOKS:

1. B.K.Sharma –Engineering Chemistry‖ Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar –Engineering Chemistry‖ Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles,Nanochemistry in biology and medicines.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2	2	1					2					2	
CO2	3	2	2	1					2					2	
CO3	3	2	2	1					2					2	
CO4	3	2	2	1					2					2	
CO5	3	2	2	1					2					2	
Category	Basic Sciences (BS)														
Approval	47th Meeting of Academic Council														

U18ESEE101	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

UNIT 1 DC CIRCUITS 12 hours

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,,Maximum Power Transfer Theorem.

UNITII AC CIRCUITS 9 hours

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNITIII ELECTRICAL MACHINES & TRANSFORMERS 9 hours

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS 9 hours

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

UNIT 5 DIGITAL ELECTRONICS 6 hours

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird,,Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, ―Fundamentals of Electrical Engineering‖, Oxford University Press, 2011.
4. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 10th Edition, 2011.
5. V. D. Toro, ―Electrical Engineering Fundamentals‖, Pearson, 2nd Edition, 2015.
6. Millman and Halkias, ―Integrated Electronics‖, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, –Basic Electrical Engineering‖, Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, –Basic Electrical Engineering‖, McGraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,—Electronic Devices and Circuits‖, McGraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						2		3	1		2	
CO2	2		3						2		3			2	
CO3	3		2						1		2			2	
CO4	3		2						3		3	1		2	
CO5	3		2						2		2	2		2	
Category	Engg Sciences (ES)														
Approval	47th Meeting of Academic Council														

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector					

UNIT I INTRODUCTION TO LIFE 6 hours

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6 hours

Plant System: basic concepts plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6 hours

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immune response.

UNIT IV HUMAN DISEASES 6hours

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6hours

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The UNITy and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)															
CO1	To understand the basic concepts of the cell and its structure														
CO2	To understand about biodiversity and its conservation														
CO3	To know the fundamentals of genetics and the immune system														
CO4	To create an awareness about human diseases														
CO5	To give a basic knowledge of the applications of transgenics														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3								2						
CO2	3								2						
CO3	3								2						
CO4	2								2						
CO5	3								2						
Category	Basic Sciences (BS)														
Approval	47th Meeting of Academic Council														

U18BSPH2L2	**WAVE OPTICS AND SEMICONDUCTOR PHYSICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	0
	Prerequisite – Higher Secondary School Physics				
	Course Designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Semiconductor Physics – Circuit branches

1) Determination of Band Gap
2) Zener diode characteristics
3) p-n junction diode Characteristics
3) Transistor Characteristics
5) V-I characteristics using LDR circuit
6) Carey Foster's Bridge

COURSE OUTCOMES (COs)	
CO1	To Understand the fundamental concept of optics
CO2	To Understand the concept of production of ultrasonic waves
CO3	To Understand the functions of semiconductor

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						2					2	
CO2	3		2						2			3		2	
CO3	3		2						2					2	
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18BSCH2L4	**CHEMISTRY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	2	0
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, ―Practical Chemistry‖, Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						2						
CO2	3		2						2						
CO3	3		2						2						
CO4	3		2						2						
CO5	3		2						2						
Category	Basic Sciences (BS)														
Approval	47th Meeting of Academic Council														

U18ESME1L2	**WORKSHOP/MANUFACTURING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.

SYLLABUS

Lectures & videos: 15 hours

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **3 lecture**
- CNC machining, Additive manufacturing **2 lecture**
- Fitting operations &power tools **2 lecture**
- Carpentry **2 lecture**
- Plastic moulding, glass cutting **2 lecture**
- Metal casting **2 lecture**
- Welding (arc welding & gas welding), brazing **2 lecture**

WORKSHOP PRACTICE:

1. Machine shop **6 hours**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **6 hours**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **9 hours**
   a) Preparation Lap joints.
   b) Mortise and Tenonjoints.
   c) Cross Half.
   d) Dove Tail.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) 9 hours**

Preparation of butt joints, lap joints and tee joints

5. Sheet Metal working **9 hours**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

6. Demonstration **6 hours**

Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., –Elements of Workshop Technology‖, Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, –Manufacturing Engineering and Technology‖,4th edition, Pearson Education India Edition, 2002.

3. Gowri P. Hariharan and A. Suresh Babu,‖Manufacturing Technology – I‖ Pearson Education, 2008.
4. Roy A. Lindberg, –Processes and Materials of Manufacture‖, 4th edition, Prentice Hall India, 1998.
5. Rao P.N., –Manufacturing Technology‖, Vol. I and Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						2					2	
CO2	3		2						2					2	
CO3	3		2						2					2	
CO4	3		2						2					2	
Category	Engg Science (ES)														
Approval	47th Meeting of Academic Council														

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONIC ENGINEERING PRACTICESLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff‘s Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3	2			1			2		3	
	CO2	3	3	2			1			2		3	1
	CO3	3	3	2			1			2		3	
	CO4	3	3	2			1			2		3	1
	CO5	3	3	2			1			2		3	1
	CO6	3	3	2			1			2		3	1
3	Category	Engg Science (ES)											
4	Approval	47th Meeting of Academic Council											

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

UNIT I LISTENING 9 hours

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9 hours

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9 hours

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9 hours

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9 hours

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1- Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1				2			3		2	3					
CO2				2			3		2	3					
CO3				2			3		2	3					

CO4				2			3		2	3		3			
CO5				2			3		2	3		3			
Category	Humanities and Social Studies (HS)														
Approval	47th Meeting of Academic Council														

U18BSMA201	**ENGINEERING MATHEMATICS – II**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by – Department of Mathematics				
OBJECTIVES	➢ The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables. ➢ Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3) hours

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3) hours

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)hours

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : = + , , 1/ and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3) hours

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3) hours

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas‘ Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green‘s, Stoke‘s and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy‘s integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3			2				2					2	
CO2	3	3			2				2					2	
CO3	3	3			2				2					2	
CO4	3	3			2				2					2	
CO5	3	3			2				2			3		2	
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18BSPH202	**SEMICONDUCTOR PHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To develop physics and engineering strategies of semiconductor materials and to discuss their functionalities in modern electronic and optoelectronic devices

UNIT 1 INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS **9 hours**

Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential:Kronig - penny and nearly free electron models - Real methods for band structure calculations; Band gaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands

UNIT 2 CARRIERS AND DOPING **9 hours**

Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration – intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Band gap engineering

UNIT 3 ELECTRICAL TRANSSORT **9 hours**

Scattering Mechanism: electron - electron and electron – phonon scattering. Macroscopic transport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field and very high field.

UNIT 4 OPTICAL TRANSSORT **9 hours**

Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties. Carrier transport - continuity equations. Optical constants: Kramers - Kronig relations.

UNIT 5 SEMICONDUCTOR AS DEVICES AND RECENT ADVANCES **9 hours**

Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductor junctions - Homo and hetero Junctions. Active and passive optoelectronic devices: performance and response enhancement (photo processes)**.**

TEXT BOOK:

1) M.N. Avadhanulu and P.G. Kshirsagar, –A Textbook of Engineering Physics‖ S.Chand Publishers, 2014**(for UNITs 1 and 2)**

2) G.Senthil Kumar, –Engineering Physics‖, VRB publishers, Chennai, 2015 (for **UNIT** 5)

REFERENCES BOOKS:

1) Kevin F Brennan, "The Physics of Semiconductors", Cambridge Univ.Press 1999.
2) Peter Y Yu and Manuel Cardona, "Fundamentals of Semiconductors",Springer, 1996.
3) Charles Kittel, "Introduction to Solid State Physics", 6th Edition, Willey, 1991.
4) D.A. Neamen, "Semiconductor Physics and Devices", 3 rdEd.,Tata McGraw-Hill,2002.
5) Jasprit Singh, "Semiconductor Optoelectronics (Physics and Technology)", McGraw-Hill, 1995.
6) Online reference: Wikipedia, NPTEL

COURSE OUTCOMES (COs)	
CO1	Understand the difference between metals, semiconductors and insulators
CO2	Understand the importance of doping to charge carrier density
CO3	Understand the electrical transport in semiconductors
CO4	Understand the difference between direct and indirect semiconductors
CO5	Understand the concept of semiconductor optoelectronic devices.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3							1	2					2	
CO2	3							1	2					2	
CO3	3							1	2					2	
CO4	3							1	2					2	

CO5	3							1	2			1		2	
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18BSCH201	**ENVIRONMENTAL SCIENCES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I NATURAL RESOURCES 9 hours

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II ECOSYSTEMS 9 hours

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III BIODIVERSITY AND ITS CONSERVATION 9 hours

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographically classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL SOLLUTION 9 hours

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste

Management: Causes, effects and control measures of urban and industrial wastes - Role ofan individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V SOCIAL ISSUES AND HUMAN SOPULATION 9 hours

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes. Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science_, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering_, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards_, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, ‒Basics of Civil Engineering|.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia_, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law_, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS**
CO1	3			2				2	2			1			
CO2	3			2				2	2			1			
CO3	3			3				2	1			1			

CO4	3			2				2	2			1			
CO5	3			3				2	2			3			
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

UNITI ALGORITHIMIC PROBLEM SOLVING 9 periods

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart ,programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

UNIT II DATA, EXPRESSIONS, STATEMENTS 9 Periods

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

UNIT III CONTROL FLOW, FUNCTIONS 9 Periods

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNITIV LISTS, TUPLES, DICTIONARIES 9 periods

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V FILES, PACKAGES 9 Periods

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS

1. Allen B. Downey, _Think Python: How to Think Like a Computer Scientist‘, 2nd edition, Updated for Python3, Shroff/O_Reilly Publishers, 2016_ (http://greenteapress.com/wp/think-python/)

2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and update dfor Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python‖, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.‟, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS**
CO1	3			2		1			2		3	2		3	
CO2	3			2		1			2		3	2		3	
CO3	3			2		1			2		3	2		3	
CO4	3			2		1			2		3	2		3	
CO5	3			2		1			2		3	2		3	
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18ESME101	**ENGINEERING GRAPHICS & DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	3	0	0	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

UNIT I TRADITIONAL ENGINEERING GRAPHICS

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

UNITII COMPUTER GRAPHICS

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

***(*Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)**

UNITIII INTRODUCTION TO ENGINEERING DRAWING (9+2Hrs)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

UNIT IV ORTHOGRAPHIC PROJECTIONS (10+2 Hrs)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP;

UNIT V PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3Hrs)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

UNITVI SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3Hrs)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planesperpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

UNITVII BUILDING DRAWING (9+2Hrs)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings,Symbols, Conventions and Abbreviations.Drawing of residential single and two storied buildingswith detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections

UNITVIII OVERVIEW OF COMPUTER GRAPHICS (12+3 Hrs)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of **UNIT**s and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;Create basic drawing of objects such as polygon and general multi-line figures;

Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top viewand side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3			2					2						
CO2	3			2					3						
CO3	3			1					2						
CO4	3			2					1						
CO5	3			2					2						
Category	Basic Science (BS)														
Approval	47th Meeting of Academic Council														

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – **PROBLEM SOLVING AND PYTHON PROGRAMMING**				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton_s method)
3. ExSOnentiation (Sower of a number)
4. Find the maximum of a list of numbers

5. Linear search and Binary search

6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (Cos)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab,NumPy and Matplotlib

Mapping of Course Outcomes with Program outcomes (Pos)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						2			2		3	
CO2	3		2						2			2		3	
CO3	3		2						2			2		3	
CO4	3		2						2			2		3	
CO5	3		2						2			2		3	
Category	Engg Sciences (ES)														
Approval	47th Meeting of Academic Council														

U18BSMA304	**PROBABILITY AND QUEUING THEORY**	**L**	**T**	**P**	**C**
	Total Contact Periods- 60	**3**	**1**	**0**	**4**
	Prerequisite – Basic knowledge in probability and statistics				
	Course Designed by : Department of Mathematics				
OBJECTIVE	➢ To develop analytical capability and to impart knowledge in Statistical methods and Queuing theory and their applications in Engineering and Technology. ➢ To develop the knowledge of Statistical methods and its applications so as to appreciate them for solving real world problems.				

UNIT I RANDOM VARIABLES (9+3)

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II TWO – DIMENSIONAL RANDOM VARIABLES (9+3)

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

UNIT III RANDOM PROCESSES (9+3)

Classification – Stationary process – Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV QUEUING MODELS (9+3)

Markovian queues – Birth and Death processes – Single and multiple server queueing models – Little's formula – Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

UNIT V ADVANCED QUEUING MODELS (9+3)

Finite source models – M/G/1 queue – PollaczekKhinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

TEXT BOOKS:

1. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007. [Units I to III]
2. Gross. D. and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student edition, 2004. [Units IV&V]

REFERENCES:

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and Performance Evaluation", Springer,3rdEdition,2006.
2. HamdyA.Taha. "Operations Research", Pearson Education, Asia, 8th Edition, 2007.
3. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition,2002.
4. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
5. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

COURSE OUTCOMES (Cos)	
CO1	Understand the notations various types of random variables and probability distributions.
CO2	Apply the concepts of two dimensional random variables.
CO3	Explain the concepts of random processes.
CO4	Describe the basic concepts of queuing models
CO5	Analyze the extended models in advanced queuing models.
CO6	Apply probabilistic theory for real time problems.

Mapping of Course Outcomes with Program outcomes (Pos)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2							2				3		
CO2		3				1						1	3		
CO3	3				1					2		2	3		
CO4				1					3	2		2	3		
CO5	3	2				1						3	3		
CO6	3	2		1	1	1			3	2		3	3		
Category	Basic Sciences (BS)														

Approval	47th Meeting of Academic Council

U18ESIT302	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –Wave optics and Basic Electrical and Electronics system				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To Introduce Different Methods Of Analog Communication And Their Significance
- To Introduce Digital Communication Methods For High Bit Rate Transmission
- To Introduce The Concepts Of Source And Line Coding Techniques For Enhancing Rating Of Transmission Of Minimizing The Errors In Transmission.
- To Introduce MAC Used In Communication Systems For Enhancing The Number Of Users.
- To Introduce Various Media For Digital Communication

UNIT I ANALOG COMMUNICATION 9

Signals – Analog and Digital, Modulation Techniques- AM – Frequency Spectrum – Vector Representation – Power Relations – Generation Of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM And PM Techniques – Frequency Spectrum – Power Relations : Generation Of FM NBFM& WBFM, Amstrong Method & Reactance Modulations.

UNIT II DIGITAL COMMUNICATION 9

Concepts Of Sampling And Sampling Theorems, Pulse Modulations:- PAM, PWM, PPM, PTM, Quantization And Coding : DCM, DM, Slope Overload Error. ADM, DPCM, OOK Systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, Applications Of Data Communication.

UNIT III INFORMATION THEORY 9

Primary Communication – Entropy, Properties, BEC, Source Coding :Shannon Fano, Huffman Coding : Noiseless Coding Theorem, BW – SNR Trade Off Codes: NRZ, RZ, AMI, HDBP, ABQ, Efficiency Of Transmissions, Error Control Codes And Applications: Convolutions & Block Codes.

UNIT IV SPREAD SPECTRUM AND MULTIPLE ACCESS METHODS 9

FDMA, TDMA, CDMA, SDMA , **Spread Spectrum and Multiple Access Methods for wireless system engineering**

UNIT V OPTICAL FIBER , SATELLITE, POWERLINE- SCADA 9

Fibers – Types: Sources, Detectors Used, Digital Filters, Optical Link - Orbits Types Of Satellites Frequency Used Link Establishment, MA Techniques Used In Satellite Communication, Earth Station; Aperture Actuators Used In Satellite – Intelsat and Insat, Power Line Carrier Communications-SCADA.

TEXT BOOKS:

1. Taub & Schiling –Principles Of Communication Systems‖ Tata McGraw Hill 2007.
2. J.Das ―Principles of Digital Communication‖ New Age International, 1986.

REFERENCES:

1. Kennedy And Davis ―Electronic Communication Systems‖ Tata McGraw Hill, 4th

Edition,1993.
2. Sklar –Digital Communication Fundamentals And Applications– Pearson Education, 2001.
3. Bary Le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.
4. B.P.Lathi –Modern Digital And Analog Communication Systems‖ Oxford University Press, 1998.
5. Frenzel 4th edn Electronic Communication Systems.

COURSE OUTCOMES (COs)	
CO1	Understand the basic working of communication systems
CO2	Apply Analog modulation techniques and their comparative analysis and applications suitability
CO3	Evaluate process of modulation and demodulation, characterization and performance parameters of transmission channels
CO4	Understand Analog to digital conversion and Digital data transmission, Multiplexing Techniques.
CO5	Summarize the multiple access techniques used in satellite communication
CO6	Outline the fibre optical system used in communication

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2							2					2	
CO2		3				1						1		2	
CO3	3				1					2		2		2	
CO4				1					3	2		2		2	
CO5	3	2		3	3	2						3		2	
CO6	3	2		3	3	2								2	
Category	Engineering Sciences (ES)														
Approval	48th meeting of the Academic Council														

U18PCIT303	**DATABASE MANAGEMENT SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Computer fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

UNIT I RELATIONAL DATABASES 10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II DATABASE DESIGN 8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTIONS 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V ADVANCED TOPICS 9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, ―Database System Concepts‖, Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, ―Fundamentals of Database Systems‖, Sixth Edition, Pearson Education, 2011.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, ―An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta,‖Database Management Systems‖, Tata McGraw Hill, 2011.4.

COURSE OUTCOMES (COs)	
CO1	Analyze the modern and futuristic database applications based on size and complexity
CO2	Apply queries using normalization criteria and optimize queries
CO3	Understand the transactions concepts and concurrency
CO4	Explain the indexing strategies in different database systems
CO5	Discuss the key challenges of advanced database systems

CO6	Evaluate how advanced databases differ from traditional databases

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3	2		3	1	3			3	3	2		3		
CO2	3	1		3	1	3			3	3	2		3		
CO3	2	1		3	1	3			3	3	2		3		
CO4	2	2		3	1	3			3	3	2		3		
CO5	2	2		3	3	3			3	3	2		3		
CO6	2	2		3	3	3			3	3	2		3		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT304	**DATA STRUCTURES AND ALGORITHMS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Fundamentals of Programming Language				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the concepts of ADTs
- To learn linear data structures – lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

UNIT I LINEAR DATA STRUCTURES – LIST 12

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 12

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue –applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES 12

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.

UNIT IV NON LINEAR DATA STRUCTURES – GRAPHS 12

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 12

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TEXT BOOKS:

1. Mark Allen Weiss, –Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, –Data Structures Using C‖, Second Edition , Oxford University Press, 2011

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, –Introduction to Algorithms‖, Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, –Data Structures and Algorithms‖, Pearson Education,1983.
3. Stephen G. Kochan, –Programming in C‖, 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, –Fundamentals of Data Structures in C‖, Second Edition, University Press, 2008

COURSE OUTCOMES (COs)	
CO1	Understand linear data structures linked list and their applications.
CO2	Demonstrate the linear data structures such as stacks, queues and their applications.
CO3	Apply the non-linear data structures such as trees, graphs in real time applications.
CO4	Analyze the various searching techniques
CO5	Evaluate the various sorting algorithms and hashing technique
CO6	Describe the overview of hashing techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2		3		2				3				3	
CO2	2	2		3		2				3				3	
CO3	3	2		3		2				3		3		3	
CO4	3	2		3		2				3		3		3	
CO5	2	2		3		2				3		3		3	
CO6	2	2		3		2				3		3		3	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT305	**OBJECT ORIENTED ANALYSIS AND DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer Fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn the basics of OO analysis and design skills.
- To learn the UML design diagrams.
- To learn to map design to code.
- To be exposed to the various testing techniques.

UNIT I UML DIAGRAMS 9

Introduction to OOAD – Unified Process – UML diagrams – Use Case – Class Diagrams– Interaction Diagrams – State Diagrams – Activity Diagrams – Package, component and

Deployment Diagrams.

UNIT II DESIGN PATTERNS 9

GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller – Design Patterns – creational – factory method – structural – Bridge – Adapter – behavioural – Strategy – observer.

UNIT III CASE STUDY 9

Case study – the Next Gen POS system, Inception -Use case Modeling – Relating Use cases – include, extend and generalization – Elaboration – Domain Models – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition.

UNIT IV APPLYING DESIGN PATTERNS 9

System sequence diagrams – Relationship between sequence diagrams and use cases Logical architecture and UML package diagram – Logical architecture refinement – UML class diagrams – UML interaction diagrams – Applying GoF design patterns.

UNIT V CODING AND TESTING 9

Mapping design to code – Testing: Issues in OO Testing – Class Testing – OO Integration Testing – GUI Testing – OO System Testing.

TEXT BOOK:

1. Craig Larman, –Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development‖, Third Edition, Pearson Education, 2005.

REFERENCES:

1. Simon Bennett, Steve Mc Robb and Ray Farmer, –Object Oriented Systems Analysis and Design Using UML‖, Fourth Edition, Mc-Graw Hill Education, 2010.
2. Erich Gamma, and Richard Helm, Ralph Johnson, John Vlissides, –Design patterns: Elements of Reusable Object-Oriented Software‖, Addison-Wesley, 1995.
3. Martin Fowler, –UML Distilled: A Brief Guide to the Standard Object Modeling La**ova**nguage‖, Third edition, Addison Wesley, 2003.
4. Paul C. Jorgensen, –Software Testing:- A Craftsman‘s Approach‖, Third Edition, Auerbach Publications, Taylor and Francis Group, 2008

COURSE OUTCOMES (COs)	
CO1	Explain OOAD concepts and various UML diagrams
CO2	Understand the object-oriented approach to analyze and select the appropriate design patterns
CO3	Illustrate about domain models and conceptual classes
CO4	Use Unified modeling Language notations to apply effective and efficient system design patterns.
CO5	Formulate the problem and designing solutions for real time projects
CO6	Compare and contrast the various testing techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	1	3		3	3	2			3					3	
CO2	1	3		3	3	2			3					3	
CO3	1	3		3	3	2			3					3	

CO4	1	3		3	3	2			3					3	
CO5	1	3		3	3	2			3	3	3	3		3	
CO6	1	3		3	3	2			3					3	
Category	Professional Core (PC)														
Apprl	48th meeting of the Academic Council														

U18PCIT306	**COMPUTER ARCHITECTURE**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer Fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies, cache memories and virtual memories.
- To learn the different ways of communication with I/O devices.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance – Instructions: Language ofthe Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation – Building a Data path – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM 9

Parallel processing challenges – Flynn_s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB_s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

COURSE OUTCOMES (COs)	
CO1	Understand the fundamental organization of computer system, operations and instructions.
CO2	Design arithmetic and logic unit in computer architecture.
CO3	Explain the concepts of pipelined execution and design control unit.
CO4	Understand parallel processing architectures and GPU.
CO5	Describe the various memory systems and its hierarchies.
CO6	Demonstrate the different ways of communication with I/O devices

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		3	3	2	3	1	3			3	1	3		
CO2	3		3	3	2	3	1	3			3	1	3		
CO3	3		2	3	2	3	1	3			3	1	3		
CO4	3		3	3	2	3	1	3			3	1	3		
CO5	2		3	3	2	3	1	3			3	3	3		
CO6	3		3	3	2	3	1	3			3	3	3		
Category	Professional Core (PC)														
Apprl	48th meeting of the Academic Council														

U18PCIT3L1	**DATABASE MANAGEMENT SYSTEMS LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Computer fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand data definitions and data manipulation commands
- To learn the use of nested and join queries
- To understand functions, procedures and procedural extensions of data bases
- To be familiar with the use of a front end tool
- To understand design and implementation of typical database applications

LIST OF EXERCISES:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements
2. Database Querying – Simple queries, Nested queries, Sub queries and Joins
3. Views, Sequences, Synonyms
4. Database Programming: Implicit and Explicit Cursors
5. Procedures and Functions
6. Triggers

7. Exception Handling
8. Database Design using ER modeling, normalization and Implementation for any application
9. Database Connectivity with Front End Tools
10. Case Study using real life database applications

COURSE OUTCOMES (COs)	
CO1	Construct data definitions and manipulation commands.
CO2	Design applications to test Nested and Join Queries
CO3	Implement simple applications that use the concept of Views
CO4	Design applications that require a Front-end Tool, ER Modelling
CO5	Analyze the use of Tables, Cursors, Views, Functions, Procedures and Triggers
CO6	Design and implement typical real time database applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	3		3		1	1		3	3	3	3		3	
CO2	2	3		3		2	3		3	3	3	3		3	
CO3	2	3		3		3	3		3	3	3	3		3	
CO4	2	3		3		3	3		3	3	3	3		3	
CO5	3	3		3		3	3		3	3	3	3		3	
CO6	3	3		3		3	3		3	3	3	3		3	
Category	Professional Core (PC)														
Apprl	48th meeting of the Academic Council														

U18PCIT3L2	**OBJECT ORIENTED PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Computer fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

LIST OF EXPERIMENTS

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.

If the type of the EB connection is domestic, calculate the amount to be paid as follows:

- First 100 units – Rs. 1 per unit
- 101-200 units – Rs. 2.50 per unit

- 201 -500 units – Rs. 4 per unit
- 501 units – Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units – Rs. 2 per unit
- 101-200 units – Rs. 4.50 per unit
- 201 -500 units – Rs. 6 per unit
- 501 units – Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following
   a. Append – add at end
   b. Insert – add at particular index
   c. Search
   d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.
    a) Decimal manipulations
    b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

COURSE OUTCOMES (COs)	
CO1	Construct Java programs for simple applications that make use of classes
CO2	Develop and implement Java programs for simple applications that make use of packages and interfaces.
CO3	Implement array list using Java
CO4	Design Java applications using generic programming, exception handling and multithreading

CO5	Implement the concept of file processing in Java
CO6	Develop real time applications using Java concepts

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	1	3		3	3	2			3	3	3	3		3	
CO2	1	3		3	3	2			3	3	3	3		3	
CO3	1	3		3	3	2			3	3	3	3		3	
CO4	1	3		3	3	2			3	3	3	3		3	
CO5	1	3		3	3	2			3	3	3	3		3	
CO6	1	3		3	3	2			3	3	3	3		3	
Category	Professional Core (PC)														
Apprl	48^{m} meeting of the Academic Council														

U18PCIT3L3	**DATA STRUCTURES LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Computer Fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithm

LIST OF EXPERIMENTS

1. Array implementation of Stack and Queue ADTs
2. Array implementation of List ADT
3. Linked list implementation of List, Stack and Queue ADTs
4. Applications of List, Stack and Queue ADTs
5. Implementation of Binary Trees and operations of Binary Trees
6. Implementation of Binary Search Trees
7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms
10. Applications of Graphs
11. Implementation of searching and sorting algorithms
12. Hashing – any two collision techniques

COURSE OUTCOMES (Cos)	
CO1	Apply the concepts of linear data structures such as list, stacks, queues and linked list.
CO2	Implement non-linear data structure operations
CO3	Construct functions to implement Graph and Tree Traversal algorithms
CO4	Design programs based on the concept of sorting and searching techniques
CO5	Design and apply structures with Hashing techniques
CO6	Identify the appropriate data structure for any given problem

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2		3		2				3				3	
CO2	2	2		3		2				3				3	
CO3	3	2		3		2				3		3		3	
CO4	3	2		3		2				3		3		3	
CO5	2	2		3		2				3		3		3	
CO6	2	3		3		2				3		3		3	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18BSMA401	**DISCRETE MATHEMATICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by:- Dept of Mathematics				
OBJECTIVES	Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do use mathematically correct terminology and notation, construct correct direct and indirect proofs, apply logical reasoning to solve a variety of problems and introduce simple concepts in graph theory.				

UNIT I MATHEMATICAL LOGIC (9+3)

Propositions and logic operators –Truth table – Equivalence – Implications – Tautologies – Laws of logic – Proofs in Propositional calculus – Inference theory – Predicate calculus.

UNIT II RELATION AND FUNCTIONS (9+3)

Different types of relations: Binary Relation – Partial Ordering Relation – Equivalence Relation – Sum and Product of Functions – bijective functions – Inverse and Composite Function

UNIT III RECURRENCE RELATIONS (9+3)

Recurrence relations – solving recurrence relation – Homogeneous and non–homogeneous recurrence relation – Generating Functions – Groups – Properties – cyclic groups and subgroups cosets – Lagrange‘s theorem.

UNIT IV GRAPH THEORY (9+3)

Introduction of Graphs – Graph terminology – Representation of Graphs – Connectivity – Euler and Hamilton path – Euler and Hamilton cycles – the Travelling sales man problem – Graph Isomorphism

UNIT V BOOLEAN ALGEBRA (9+3)

Boolean algebra – Partial order Relations on Boolean algebra – Boolean homomorphism – Disjunctive and conjunctive normal forms – Boolean functions.

TEXT BOOKS

1. Tremblay J.P and Manohar. R, –Discrete Mathematical Structures with Application to Computer Sciencel, McGraw Hill Book Company, International Edition, 1987

2. Kenneth H. Rosen, –Discrete Mathematics and its Applications‖, McGraw Hill Book Company 1999.

REFERENCE BOOKS

1. Ralph P., Grimaldi, –Discrete and Combinatorial Mathematics‖, Pearson Education, Fifth Edition, New Delhi. 2008
2. Venkataraman M.K, Discrete Mathematics‖, The National Publishing Company2000.
3. T. Veerarajan, –Discrete Mathematics‖, Mc Graw Hill Publications, 2006.

COURSE OUTCOMES (COs)	
CO1	Define and analyze the fundamental Mathematical Concepts such as sets relations, and functions.
CO2	Learn the steps in proportional and Predicate logic.
CO3	Expose to the concept of recurrence relations, generating functions, group, and cyclic groups, subgroups.
CO4	Define the terminologies of graph and develop the given problems as graph networks and solve with techniques of graph theory.
CO5	Understand the terminologies of Boolean algebra and mathematical induction,
CO6	Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2	3	1		3	1	1	1	3	1		3		
CO2	3	3		2	3	2		3	2		2	1	3		
CO3	3	2	1		2	2		2	2		2	1	3		
CO4	3	2	2		2	1	2		1	2	1		3		
CO5	3	2		2		2	2	1	2	1	2	1	3		
CO6	3	2	2	2	2	2	2	1	2	1	2	1	3		
Category	Basic Science (BS)														
Approval	48th meeting of the Academic Council														

U18PCIT401	**WEB PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Internet Programming				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the concepts and architecture of the World Wide Web.
- To understand and practice mark up languages
- To understand and practice embedded dynamic scripting on client side Internet Programming
- To understand and practice web development techniques on client-side

UNIT I SCRIPTING 9

Web page Designing using HTML - Scripting basics- Client side and server side scripting. Java Script-Object, names, literals, operators and expressions- statements and features- events -

windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.-HTML5- CSS3- HTML 5 canvas - Web site creation using tools.

UNIT II JAVA 9

Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces –Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling.

UNIT III JDBC 9

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– InetAddress class – URL class- TCP sockets - UDP sockets, Java Beans –RMI.

UNIT IV APPLETS 9

Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP.

UNIT V XML AND WEB SERVICES 9

Xml – Introduction-Form Navigation-XML Documents- XSL – XSLT- Web services-UDDI-WSDL-Java web services – Web resources.

TEXT BOOKS:

1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How To Program 5th Edition.
2. Herbert Schildt, Java - The Complete Reference, 7th Edition. Tata McGraw- HillEdition.
3. Michael Morrison XML Unleashed Tech media SAMS.

REFERENCES:

1. John Pollock, Javascript - A Beginners Guide, 3rd Edition –- Tata McGraw-Hill Edition.
2. Keyur Shah, Gateway to Java Programmer Sun Certification, Tata McGraw Hill, 2002.
3. http:// speckyboy.com/2015/01/12/free-**web**-design-**ebooks**-2014

COURSE OUTCOMES (COs)	
CO1	Acquire knowledge about functionalities of world wide web
CO2	Explore markup languages features and design interactive web pages using them
CO3	Experiment Client side validation using scripting languages
CO4	Implement Open source JavaScript library functions
CO5	Design front end web page and connect to the back end databases
CO6	Explain the functions of client and servers on Web.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	**1**		**3**	**2**	**2**	**2**				**2**					**3**
CO2	**1**		**3**	**2**	**2**	**2**				**2**					**3**

CO3	**1**		**3**	**2**	**2**	**2**				**2**		**2**			**3**
CO4	**1**		**3**	**2**	**2**	**2**						**2**			**3**
CO5	**1**		**3**	**2**	**2**	**2**						**2**			**3**
CO6	**1**		**3**	**2**	**2**	**2**						**2**			**3**
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT402	**OPERATING SYSTEM PRINCIPLES**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer Organization and Architecture				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

To understand basic operating system controls the computing resources and provide services to the users. This course provides an introduction to the operating system functions, design and implementation.

UNIT I OPERATING SYSTEMS OVERVIEW 9

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization-Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT II PROCESS MANAGEMENT 9

Processes-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads- Overview, Multicore Programming, Multithreading Models; Windows 7 - Thread and SMP Management. Process Synchronization - Critical Section Problem, Mutex Locks, Semophores, Monitors; CPU Scheduling and Deadlocks.

UNIT III STORAGE MANAGEMENT 9

Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

UNIT IV I/O SYSTEMS 9

Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage- File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory Structure, Allocation Methods, Free Space Management; I/O Systems.

UNIT V CASE STUDY 9

Linux System- Basic Concepts; System Administration-Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services; Virtualization- Basic Concepts, Setting Up Xen,VMware on Linux Host and Adding Guest OS

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, –Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCES:

1. William Stallings, ―Operating Systems – Internals and Design Principles‖, 7th Edition, Prentice Hall, 2011.
2. Andrew S. Tanenbaum, –Modern Operating Systems‖, Second Edition, Addison Wesley, 2001.
3. Charles Crowley, –Operating Systems: A Design-Oriented Approach‖, Tata McGraw Hill Education‖, 1996.
4. D M Dhamdhere, –Operating Systems: A Concept-Based Approach‖, Second Edition, Tata McGraw-Hill Education, 2007.
5. https://www.free-**ebooks**.net/**ebook**/The-Easy-Guide-to-**Operating-Systems**

COURSE OUTCOMES (COs)	
CO1	Recall the fundamental components of a computer operating system, Basics of operating system principles and System calls. Define process state and scheduler. List mass storage devices. Recall the concepts of storage allocation strategies, files system and Linux System.
CO2	Describe, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, file systems and virtualization concepts.
CO3	Demonstrate and execute basic system calls, Schedulers, Memory management systems, Virtual Memory and Paging systems.
CO4	Examine and Experiment the performance of scheduling algorithm, memory management strategies and disk storage structures
CO5	Design and develop Linux multifunction server and Local network services
CO6	Develop Virtualization Concept in OS by setting Up Xen, VMware on Linux Host and Adding Guest OS

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3	2	2						2			1		1
CO2		3	2	2						2			2		2
CO3		3	2	2						2			2		2
CO4		3	2	2						2			2	2	2
CO5	3				2							2	2		2
CO6	3		3		2	3		2				2	2		2
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT403	**SOFTWARE ENGINEERING METHODOLOGIES**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Fundamentals of Computing and Programming				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn about generic models of software development process.
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the different design techniques and their implementation.
- To learn various testing and maintenance measures.

UNIT I SOFTWARE PROCESS AND PROJECT MANAGEMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation – LOC and FP Based Estimation,

COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis - Risk Management.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III RE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV TESTING AND IMPLEMENTATION 9

Software testing fundamentals-Internal and external views of Testing-white box testing -basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques: Coding practices-Refactoring.

UNIT V PROJECT MANAGEMENT 9

Estimation – FP Based, LOC Based, Make/Buy Decision, COCOMO II - Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM - Scheduling and Tracking –Relationship between people and effort, Task Set & Network, Scheduling, EVA - Process and Project Metrics.

TEXT BOOKS:

1. Roger S. Pressman, –Software Engineering – A Practitioner"s Approach|, Seventh Edition, Mc Graw-Hill International Edition, 2010.

REFERENCES:

1. Ian Sommerville, –Software Engineering|, 9th Edition, Pearson Education Asia, 2011.
2. Rajib Mall, –Fundamentals of Software Engineering|, Third Edition, PHI Learning Private Limited, 2009.
3. Pankaj Jalote, –Software Engineering, A Precise Approach|, Wiley India, 2010.
4. Kelkar S.A., –Software Engineering|, Prentice Hall of India Pvt Ltd, 2007.
5. Stephen R.Schach, –Software Engineering|, Tata McGraw-Hill Publishing Company Limited, 2007.
6. http:// www.onlineprogrammingbooks.com/**software-engineering**

COURSE OUTCOMES (COs)	
CO1	Explain the basic concept of Software engineering and Estimation models.
CO2	Understand the concepts of software requirements, analysis and specification.
CO3	Design various software models
CO4	Understand the basic concepts of testing and its implementation.
CO5	Implement and deploy the software.
CO6	Apply the project management in software engineering tasks.
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3	1							2	2	2	2	3		
CO2	3	1							2	2	2	2	3		
CO3	3	1							2	2	2	2	3		
CO4	3	1							2	2	2	2	3		
CO5	3	1							2	2	2	2	3		
CO6	3	1							2	2	2	2	3		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18ESIT404	**DIGITAL SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Basic Electrical and Electronics Engg				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES:

- To introduce the concept of digital and binary systems
- To design and analyze combinational logic circuits.
- To design and analyze sequential logic circuits.
- To understand the basic software tools for the design and implementation of digital circuits and systems.

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 9

Review of Number Systems – Arithmetic Operations – Binary Codes – Boolean Algebra and Theorems – Boolean Functions – Simplification of Boolean Functions using Karnaugh Map and Tabulation Methods – Logic Gates – NAND and NOR Implementations.

UNIT II COMBINATIONAL LOGIC 9

Combinational Circuits – Analysis and Design Procedures – Circuits for Arithmetic Operations, Code Conversion – Decoders and Encoders – Multiplexers and Demultiplexers – Introduction to HDL– HDL Models of Combinational circuits.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 9

Sequential Circuits – Latches and Flip Flops – Analysis and Design Procedures – State Reduction and State Assignment – Shift Registers – Counters – HDL for Sequential Logic Circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.

UNIT V MEMORY AND PROGRAMMABLE LOGIC 9

RAM and ROM – Memory Decoding – Error Detection and Correction – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Application Specific Integrated Circuits.

TEXT BOOK:

1 Morris Mano M. and Michael D. Ciletti, –Digital Design‖, IV Edition, Pearson Education, 2008.

REFERENCES:

1. John F. Wakerly, –Digital Design Principles and Practices‖, Fourth Edition, Pearson Education, 2007.
2. Charles H. Roth Jr, –Fundamentals of Logic Design‖, Fifth Edition – Jaico Publishing House, Mumbai, 2003.
3. Donald D. Givone, –Digital Principles and Design‖, Tata Mcgraw Hill, 2003.
4. Kharate G. K., –Digital Electronics‖, Oxford University Press, 2010.

COURSE OUTCOMES (COs)	
CO1	Understand the basic concepts of Boolean algebra and to simplify the Boolean expression using K-Map and Tabulation techniques.
CO2	Demonstrate Boolean simplification techniques and to design a combinational hardware circuit.
CO3	Design and analyze given digital circuit – Synchronous sequential.
CO4	Experiment and analyze given digital circuit – Asynchronous sequential.
CO5	Describe memory and programmable logics.
CO6	Implement Application Specific Integrated Circuits

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1		3	3						2	2					2
CO2		3	3						2	2					2
CO3	2	3	3						2	2					2
CO4	2	3	3						2	2					2
CO5	2	2	2						2	2					2
CO6	2	2	2						2	2					2
Category	Engineering Sciences (ES)														
Approval	48th meeting of the Academic Council														

U18PCIT405	**DATA COMMUNICATION AND COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer Fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To get the idea of choosing the required functionality at each layer for a given application
- To trace the flow of information from one node to another node in the network.
- To understanding of division of network functionalities in to layers
- To understand the component required to build different types of networks
- To identify the solution for the functionalities in each layer.

UNIT I APPLICATION LAYER **9**

Network Architecture – Layers - HTTP – DNS – E-Mail (SMTP, MIME, POP3, IMAP, Web Mail), FTP, Telnet - SNMP.

UNIT II TRANSPORT LAYER **9**

User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Flow Control – Congestion Control – Queuing - Discipline Introduction to Quality of services (QOS).

UNIT III NETWORK LAYER **9**

Circuit Switching - Packet Switching Virtual Circuit Switching – IP – ARP – DHCP – ICMP – Routing – RIP – OSPF – Subnetting – CIDR – Interdomain Routing – BGP – IPV6 Basic Features – Inter Domain Multicast – Congestion Avoidance in Network Layer.

UNIT IV DATA LINK LAYER **9**

Channel access on links – SDMA – TDMA – FDMA – CDMA – Hybrid Multiple Access Techniques – Issues in the Data Link Layer – Framing - Error correction and detection – Link Level Flow Control – Medium Access – Ethernet – Token Ring – FDDI – Wireless LAN – Bridges and Switches.

UNIT V DATA COMMUNICATIONS **9**

Data Transmission – Transmission Media – Signal Encoding Techniques – Multiplexing – Spread Spectrum.

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, ―Computer Networking, A Top-Down Approach Featuring the Internet‖, Third Edition, Pearson Education, 2006.
2. Larry L. Peterson, Bruce S. Davie, ―Computer Networks: A Systems Approach‖, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
3. William Stallings, ―Data and Computer Communications‖, Eighth Edition, Pearson Education, 2011.

REFERENCES:

1 Nader F. Mir, ―Computer and Communication Networks‖, First Edition, Pearson Education, 2007.

2 Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach ―, McGraw Hill Publisher, 2011.

3 Behrouz A. Forouzan, ―Data communication and Networking‖, Tata McGraw-Hill, 2004.

COURSE OUTCOMES (COs)	
CO1	Understand basic concepts of computer network technology.
CO2	Explain Data Communications System and its components.
CO3	Classify the different types of network topologies and protocols.
CO4	Discuss the layers of the OSI model and TCP/IP and to explain the function(s) of each layer.
CO5	Understand the different types of network devices and their functions.
CO6	Apply signal Encoding techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2			3	2					2			3		
CO2		1		2						2			1		
CO3	2				3	3				2			3		
CO4	1	1	2	2						2			1		
CO5	1		3		1					2			2		

CO6		1								2			1		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT4L1	**DATA COMMUNICATION AND COMPUTER NETWORKS LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – TCP/IP Principles and Architectures				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To analyze a communication system by separating out the different functions provided by the network;
- To understand that there are fundamental limits to any communications system;
- To understand the general principles behind multiplexing, addressing, routing, reliable transmission and other stateful protocols as well as specific examples of each;
- To understand what FEC is and how CRCs work;
- To compare communications systems in how they solve similar problems;
- To have an informed view of both the internal workings of the Internet and of a number of common Internet applications and protocols.

List of Experiments:

1. PC to PC Communication
2. Parallel Communication using 8 bit parallel cable
3. Serial communication using RS 232CEthernet LAN protocol
4. To create scenario and study the performance of CSMA/CD protocol through simulation
   Token bus and token ring protocols
5. To create scenario and study the performance of token bus and token ring protocols through simulation
6. Wireless LAN protocols
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Implementation and study of stop and wait protocol
9. Implementation and study of Goback-N and selective repeat protocols
10. Implementation of distance vector routing algorithm
11. Implementation of Link state routing algorithm
12. Implementation of Data encryption and decryption
13. Transfer of files from PC to PC using Windows / Unix socket processing

References:

1. http:// www.iconscope.net/**network-laboratory**-manual.pdf

COURSE OUTCOMES (COs)	
CO1	Use knowledge to implement client server applications.
CO2	Develop skills in UNIX socket programming.
CO3	Develop skills to use simulation tools.
CO4	Analyse the performance of network protocols and network traffic.

CO5	Analyse the performance of various network tools and network programming
CO6	Implement encryption and decryption techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1			2	2					2	2				1	1
CO2			2	2					2	2				1	
CO3			2	2					2	2				2	L
CO4			2	2						2				1	
CO5			2	2						2				2	
CO6			2	2						2				1	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT4L2	**WEB PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Internet Programming				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand program basic functions in Javascript and DHTML
- To use Javascript and DHTML to create web pages with advanced interactivity
- To use variables, conditionals, and loops in Javascript and DHTML programs
- To use Javascript to control browser frames, windows and to create functional forms
- To use Cascading Style Sheets (CSS) to design web pages and to create web pages with specialized fonts and design elements

LIST OF EXPERIMENTS:

1. Write a html program for Creation of web site with forms, frames, links, tables etc
2. Design a web site using HTML and DHTML. Use Basic text Formatting, Images,
3. Create a script that asks the user for a name, then greets the user with "Hello" and the user name on the page
4. Create a script that collects numbers from a page and then adds them up and prints them to a blank field on the page.
5. Create a script that prompts the user for a number and then counts from 1 to that number displaying only the odd numbers.
6. Create a script that will check the field in Assignment 1 for data and alert the user if it is blank. This script should run from a button.
7. Using CSS for creating web sites
8. Creating simple application to access data base using JDBC Formatting HTML with CSS.
9. Program for manipulating Databases and SQL.
10. Program using PHP database functions.
11. Write a web application that functions as a simple hand calculator, but also keeps a "paper trail" of all your previous work
12. Install Tomcat and use JSP and link it with any of the assignments above
13. Reading and Writing the files using .Net
14. Write a program to implement web service for calculator application
15. Implement RMI concept for building any remote method of your choice.

References:

1. http:// docsfiles.com/**pdf_web_programming_lab**_manual.html

COURSE OUTCOMES (COs)	
CO1	Understand the basic concepts of the internet and insights of internet programming.
CO2	Demonstrate the important HTML tags for designing static pages.
CO3	Design web pages using Cascading Style Sheets.
CO4	Demonstrate HTML web pages accessing database using JDBC.
CO5	Select web application development software tools i.e. Ajax, PHP and XML etc.
CO6	Identify the environments currently available on the market to design web sites.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1		1	3	2	2					2					3
CO2		1	3	2	2					2					3
CO3		1	3	2	2				2	2					3
CO4		1	3	2	2				2	2					3
CO5		1	3	2	2				2	2		2			3
CO6		1	3	2	2				2	2		2			3
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT4L3	**OPERATING SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Operating System				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- Understand the basics of operating systems like kernel,shell, types and views of operating systems
- Describe the various CPU scheduling algorithms and remove deadlocks.
- Explain various memory management techniques and concept of thrashing
- Use disk management and disk scheduling algorithms for better utilization of external memory.
- Recognize file system interface, protection and security mechanisms.
- Explain the various features of distributed OS like Unix, Linux, windows etc

LIST OF EXPERIMENTS:

1. Basics of UNIX commands.
2. Shell Programming.
3. Implement the following CPU scheduling algorithms
   a) Round Robin b) SJF c) FCFS d) Priority
4. Implement all file allocation strategies
   a) Sequential b) Indexed c) Linked
5. Implement Semaphores

6. Implement all File Organization Techniques
a) Single level directory b) Two level c) Hierarchical d) DAG
7. Implement Bankers Algorithm for Dead Lock Avoidance
8. Implement an Algorithm for Dead Lock Detection
9. Implement e all page replacement algorithms
   a) FIFO b) LRU c) LFU
10. Implement Shared memory and IPC
11. Implement Paging Technique of memory management.
12. Implement Threading & Synchronization Applications

Reference:

1. http://www.faadooengineers.com/threads/5366-**Operating-System-ebook**

COURSE OUTCOMES (COs)	
CO1	Demonstrate the basics of operating systems like kernel, shell, types and views of operating systems.
CO2	Implement the various CPU scheduling algorithms and remove deadlocks.
CO3	Analyse various memory management techniques and concept of thrashing
CO4	Explain disk management and disk scheduling algorithms for better utilization of external memory.
CO5	Evaluate file system interface
CO6	Evaluate protection and security Mechanisms

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	**2**	**2**	**2**						**2**			**2**		**2**	
CO2	**2**	**3**	**3**						**2**			**2**		**2**	
CO3	**2**	**3**	**3**						**2**			**2**		**2**	
CO4	**2**	**3**	**3**									**2**		**2**	
CO5	**2**	**3**	**3**		**2**						**2**	**2**		**2**	
CO6	**2**	**3**	**3**		**2**						**2**	**2**		**2**	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT501	**DATA MINING**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Database Management System				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand data warehouse concepts, architecture, business analysis and tools
- To understand data pre-processing and data visualization techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.

UNIT I DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE

ANALYTICAL PROCESSING (OLAP) **9**

Basic Concepts – Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors – Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

UNIT II DATA MINING – INTRODUCTION **9**

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization , Data Visualization, Data similarity and dissimilarity measures.

UNIT III DATA MINING – FREQUENT PATTERN ANALYSIS **9**

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT IV CLASSIFICATION AND CLUSTERING **9**

Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis -Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

UNIT V WEKA TOOL **9**

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database – Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

TEXT BOOK:

1. Jiawei Han and Micheline Kamber, ―Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.

REFERENCES:

1. Alex Berson and Stephen J.Smith, ―Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, Shyam Diwakar and V. Ajay, ―Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, ―Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.

COURSE OUTCOMES (COs)	
CO1	Explain the basic concepts of data warehouse, business analysis and OLAP system
CO2	Implement suitable pre-processing and visualization techniques for data analysis
CO3	Demonstrate the frequent pattern and association rule mining techniques for data analysis
CO4	Interpret appropriate classification and clustering techniques for data analysis
CO5	Understand the roles that data mining plays in various fields and manipulate different data mining techniques

CO6	Apply data mining algorithms to build analytical applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	1	1	2	3	3	2			3	3		2	3		
CO2	1	1	2	3	3	2			3	3		2	3		
CO3	1	1	2	3	3	2			3	3		2	3		
CO4	1	1	2	3	3	2			3	3		2	3		
CO5	1	1	2	3	3	2			3	3		2	3		
CO6	1	1	2	3	3	2			3	3		2	3		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT502	**MOBILE COMMUNICATION**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system .
- To be familiar with the network layer protocols and Ad-Hoc networks.
- To know the basis of transport and application layer protocols.
- To gain knowledge about different mobile platforms and application development.

UNIT I INTRODUCTION 9

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA

UNIT II MOBILE TELECOMMUNICATION SYSTEM 9

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS-UMTS – Architecture – Handover – Security

UNIT III MOBILE NETWORK LAYER 9

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER 9

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

UNIT V MOBILE PLATFORMS AND APPLICATIONS 9

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

TEXT BOOKS:

1. Jochen Schiller, ―Mobile Communications‖, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, ―Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012

REFERENCES

1. Dharma Prakash Agarval, Qing and An Zeng, –Introduction to Wireless and Mobile systems‖,Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, ―Principles of Mobile Computing‖, Springer, 2003.
3. William.C.Y.Lee,―Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition,TataMcGraw Hill Edition ,2006.
4. C.K.Toh, ―AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.
5. Android Developers : http://developer.android.com/index.html

COURSE OUTCOMES (COs)	
CO1	Eexplain the basics concepts of mobile telecommunication systems.
CO2	Describe generations of telecommunication systems in wireless network.
CO3	Examine the functionality of MAC, network layer and to Identify a routing protocol for a given Ad hoc network
CO4	Classify the functionality of Transport and Application layers
CO5	Sketch a mobile application using android/blackberry/ios/Windows SDK
CO6	Identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	2		3	3	1			3	1		2		2	
CO2	2	2		3	3	1			3	1		2		2	
CO3	2	2		3	3	1			3	1		2		2	
CO4	2	2		3	3	1			3	1		2		2	
CO5	2	2		3	3	1			3	1		2		2	
CO6	2	2		3	3	1			3	1		2		2	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT503	**PRINCIPLES OF ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Computer fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the various characteristics of Intelligent agents

- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

UNIT I INTRODUCTION 9

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II PROBLEM SOLVING METHODS 9

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games

UNIT III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information

UNIT IV SOFTWARE AGENTS 9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT V APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

TEXT BOOKS:

1. S. Russell and P. Norvig, –Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.

COURSE OUTCOMES (COs)	
CO1	Classify the basic concepts of AI and Problem Solving Approach to Typical AI problems
CO2	Operate the apt agent strategy to solve a given problem
CO3	Design software agents to solve a problem
CO4	Explain applications for NLP that use Artificial Intelligence

CO5	Describe the architecture for Intelligent Agents and agent communication
CO6	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3	2		3	3			2	3	2	1	2		3	
CO2	3	2		3	3			2	3	2	1	2		3	
CO3	3	2		3	3			2	3	2	1	2		3	
CO4	3	2		3	3			2	3	2	1	2		3	
CO5	3	2		3	3			2	3	2	1	2		3	
CO6	3	2		3	3			2	3	2	1	2		3	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT504	**THEORY OF COMPUTATION**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Mathematics-set theory				
	Course Designed by:- Dr.A,Kumaravel, Dept of Information Technology				

OBJECTIVES

- To understand the language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To understand un decidable problems and NP class problems.

UNIT I AUTOMATA FUNDAMENTALS 9

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions

UNIT II REGULAR EXPRESSIONS AND LANGUAGES 9

Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata.

UNIT III CONTEXT FREE GRAMMAR AND LANGUAGES 9

CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

UNIT IV PROPERTIES OF CONTEXT FREE LANGUAGES 9

Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

UNIT V UNDECIDABILITY 9

Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post_s Correspondence Problem, The Class P and NP.

TEXT BOOK:

1. J.E.Hopcroft, R.Motwani and J.D Ullman, ―Introduction to Automata Theory, Languages and Computations‖, Second Edition, Pearson Education, 2003.

REFERENCES:

1. H.R.Lewis and C.H.Papadimitriou, ―Elements of the theory of Computation, Second Edition, PHI, 2003.
2. J.Martin, ―Introduction to Languages and the Theory of Computation, Third Edition, TMH, 2003.
3. Micheal Sipser, ―Introduction of the Theory and Computation, Thomson Brokecole, 1997

COURSE OUTCOMES (COs)	
CO1	Create automata, regular expression for any pattern.
CO2	Design Context free grammar for any construct.
CO3	Construct Turing machines for regular language and non regular languages.
CO4	Select the decidable problems NP Hard Problems
CO5	Identify the concepts of normal forms and Programming Techniques for TM
CO6	Demonstrate advanced knowledge of formal computation and its relationship to languages

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3	2	1	1			1	3	2	2	2	3		
CO2	3	3	2	1	1			1	3	2	2	2	3		
CO3	3	3	2	1	1			1	3	2	2	2	3		
CO4	3	3	2	1	1			1	3	2	2	2	3		
CO5	3	3	2	1	1			1	3	2	2	2	3		
CO6	3	3	2	1	1			1	3	2	2	2	3		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT5L1	**DATA MINING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Database management system				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To be familiar with the algorithms of data mining,
- To be acquainted with the tools and techniques used for knowledge discovery in databases.
- To be exposed to web mining and text mining
-

LIST OF EXPERIMENTS:

- Creation of a Data Warehouse.
- Apriori Algorithm.

- FP-Growth Algorithm.
- K-Means Clustering.
- One Hierarchical Clustering Algorithm.
- Bayesian Classification.
- Decision Tree.
- Support Vector Machines.
- Applications of Classification for Web Mining.
- Case Study on Text Mining or Any Commercial Application.

COURSE OUTCOMES (COs)	
CO1	Demonstrate data mining techniques and methods to large data sets.
CO2	Compare and contrast the various classifiers use Data Mining Tools
CO3	Select association rules, Classification algorithms
CO4	Implement K-Means Clustering, one hierarchical clustering algorithm
CO5	Operate case Study on text mining or any commercial application
CO6	Execute the knowledge retrieved through solving problems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	1	1	2	3	3	2			3	3		2		3	
CO2	1	1	2	3	3	2			3	3		2		3	
CO3	1	1	2	3	3	2			3	3		2		3	
CO4	1	1	2	3	3	2			3	3		2		3	
CO5	1	1	2	3	3	2			3	3		2		3	
CO6	1	1	2	3	3	2			3	3		2		3	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT5L2	**IT- WORKSHOP LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Matrix manipulation				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES
- To be familiar with the MATLAB GUI and basic tool boxes
- To be exposed to vector and matrix operations
- To be familiar with arithmetic, logical and relational operations on matrix

LIST OF EXPERIMENTS:
1. Introduction to SDK of MATLAB
2. Basic Syntax and scalar arithmetic operations and calculations
3. Working with formulas
4. Arithmetic operations in matrix data
5. Matrix operations (Inverse, Transpose)
6. Reading an image file
7. Reading from and writing to a text file
8. Introduction to toolboxes
9. Data visualization and plotting

10. Relational operators in data
11. Logical operation in data
12. Loops in MATLAB
13. Computing Eigen value for a matrix
14. Random number generation – Monte carlo methods

REFERENCES:

1. Holly Moore, ―MATLAB for Engineers‖ Third Edition – Pearson Publications
2. Stephen J. Chapman, ‒MATLAB Programming for Engineers‖ Fourth Edition –Thomson learning.

COURSE OUTCOMES (COs)	
CO1	Implement data handling in MATLAB environment and to solve simple matrix problems.
CO2	Operate built-in toolboxes and be familiar with arithmetic, logical and relational operations on matrix
CO3	Design to vector and matrix operations and be familiar with the MATLAB GUI and basic tool boxes
CO4	Recognize Knowledge in Data visualization and plotting
CO5	Report with Random number generation – Monte carlo methods
CO6	Formulate and control simple plot and user-interface graphics objects in MATLAB.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	2	1	3	3			1	3	1	1	2		3	
CO2	2	2	1	3	3			1	3	1	1	2		3	
CO3	2	2	1	3	3			1	3	1	1	2		3	
CO4	2	2	1	3	3			1	3	1	1	2		3	
CO5	2	2	1	3	3			1	3	1	1	2		3	
CO6	2	2	1	3	3			1	3	1	1	2		3	
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT601	**GRID AND CLOUD COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To identify the technical foundations of cloud systems architectures. Analyze the problems and solutions to cloud application problems.
- To apply principles of best practice in cloud application design and management.
- To identify and define technical challenges for cloud applications and assess their importance

UNIT I INTRODUCTION 9

Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network based systems – clusters of cooperative computers – Grid computing Infrastructures – cloud computing – service oriented architecture – Introduction to Grid Architecture and standards – Elements of Grid – Overview of Grid Architecture.

UNIT II GRID SERVICES 9

Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements – Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services.

UNIT III VIRTUALIZATION 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software – Pros and Cons of cloud computing – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT IV PROGRAMMING MODEL 9

Open source grid middleware packages – Globus Toolkit (GT4) Architecture , Configuration – Usage of Globus – Main components and Programming model – Introduction to Hadoop Framework – Map reduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.

UNIT V SECURITY 9

Trust models for Grid security environment – Authentication and Authorization methods – Grid security infrastructure – Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.

TEXT BOOKS:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, ―Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet‖, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.

REFERENCES:

1. Jason Venner, ―Pro Hadoop- Build Scalable, Distributed Applications in the Cloud‖, A Press, 2009
2. Tom White, ―Hadoop The Definitive Guide‖, First Edition. O‘Reilly, 2009
3. Bart Jacob (Editor), ―Introduction to Grid Computing‖, IBM Red Books, Vervante, 2005
4. Ian Foster, Carl Kesselman, ―The Grid: Blueprint for a New Computing Infrastructure‖, 2nd Edition, Morgan Kaufmann
5. Frederic Magoules and Jie Pan, ―Introduction to Grid Computing‖ CRC Press, 2009

COURSE OUTCOMES (COs)	
CO1	Implement grid computing techniques to solve large scale scientific problems.
CO2	Understand and apply the concept of virtualization.
CO3	Use the grid and cloud tool kits.
CO4	Apply the security models in the grid and the cloud environment.

CO5	Discuss about the basic concepts of Trust models for Grid security environment.
CO6	Describe the basic concepts of Trust models for Cloud Infrastructure security.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1			1	3	3	1				1		2			2
CO2			1	3	3	1				1		2			2
CO3			1	3	3	1				1		2			2
CO4			1	3	3	1				1					2
CO5			1	3	3	1				1					2
CO6			1	3	3	1				1					2
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT602	**HUMAN COMPUTER INTERACTION**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Principles of Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To design, implement and evaluate effective and usable graphical computer interfaces.
- To describe and apply core theories, models and methodologies from the field of HCI.
- To describe and discuss current research in the field of HCI.
- To implement simple graphical user interfaces using the Java Swing toolkit.
- To describe special considerations in designing user interfaces for older adults.

UNIT I FOUNDATIONS OF HCI 9

The Human: I/O Channels – Memory – Reasoning And Problem Solving; The Computer: Devices – Memory – Processing And Networks; Interaction: Models – Frameworks – Ergonomics – Styles – Elements – Interactivity- Paradigms.

UNIT II DESIGN & SOFTWARE PROCESS 9

Interactive Design Basics – Process – Scenarios – Navigation – Screen Design – Iteration And Prototyping. HCI In Software Process – Software Life Cycle – Usability Engineering – Prototyping In Practice – Design Rationale. Design Rules – Principles, Standards, Guidelines, Rules. Evaluation techniques – Universal Design.

UNIT III MODELS AND THEORIES 9

Cognitive Models –Socio-Organizational Issues And Stake Holder Requirements – Communication And Collaboration Models-Hypertext, Multimedia And WWW.

UNIT IV MOBILE HCI 9

Mobile Ecosystem: Platforms, Application Frameworks- Types Of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements Of Mobile Design, Tools

UNIT V WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays

And Virtual Pages, Process Flow - Case Studies.

TEXT BOOK

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, –Human Computer Interaction‖, 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, –Mobile Design And Development‖, First Edition , O"Reilly Media Inc., 2009 (UNIT –IV)

COURSE OUTCOMES (COs)	
CO1	Apply effective dialog For Human Computer Interaction.
CO2	Implement HCI for common individuals and persons with disabilities.
CO3	Describe the importance of user feedback.
CO4	Explain the HCI implications for designing multimedia/ ecommerce/ e-learning web sites.
CO5	Design and develop appropriate user interface.
CO6	Develop context based user experience models.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	1	2	2										2		
CO2	1	2	2							3		3	2		
CO3	1	2	2							3		3	2		
CO4	1	2	2										2		
CO5	1	2	2										2		
CO6	1	2	2										2		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT603	**DATA ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Mining Techniques				
	Course Designed by:- Dr.A.Kumarvel, Dept of Information Technology				

OBJECTIVES

- To designing the tables and graphs that will be used to display the results before any numerical analysis is started can help focus the statistical work.
- To understand the combination of depths and times to compare between treatments, and include in the tables or graphs, may be fixed by the objectives.

UNIT I INTRODUCTION TO BIG DATA 8

Introduction to Big Data Platform – Challenges of Conventional Systems – Web Data – Evolution Of Analytic Scalability, Analytic Processes And Tools, Analysis Vs Reporting – Modern Data Analytic Tools, Statically Concepts: Sampling Distributions, Resampling, Statistical Inference, Prediction Error.

UNIT II DATA ANALYSIS 12

Regression Modeling, Multivariate Analysis, Bayesian Modeling, Inference And Bayesian Networks, Support Vector And Kernel Methods, Analysis Of Time Series: Linear Systems Analysis, Nonlinear Dynamics – Rule Induction – Neural Networks: Learning And Generalization, Competitive Learning, Principal Component Analysis And Neural Networks; Fuzzy Logic: Extracting Fuzzy Models From Data, Fuzzy Decision Trees, Stochastic Search Methods.

UNIT III MINING DATA STREAMS 8

Introduction To Streams Concepts – Stream Data Model And Architecture – Stream Computing, Sampling Data In A Stream – Filtering Streams – Counting Distinct Elements In A Stream – Estimating Moments – Counting Oneness In A Window – Decaying Window – Real-time Analytics Platform(RTAP) Applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

UNIT IV FREQUENT ITEMSETS AND CLUSTERING 9

Mining Frequent Item sets – Market Based Model – Apriori Algorithm – Handling Large Data Sets In Main Memory – Limited Pass Algorithm – Counting Frequent Item sets In A Stream – Clustering Techniques – Hierarchical – K- Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern Based Clustering Methods – Clustering In Non-Euclidean Space – Clustering For Streams And Parallelism.

UNIT V FRAMEWORKS AND VISUALIZATION 9

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed File Systems – Visualizations – Visual Data Analysis Techniques, Interaction Techniques; Systems and Applications

TEXT BOOKS:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman And Jeffrey David Ullman, Mining Of Massive Datasets,Cambridge University Press, 2012.

REFERENCES:

1. Bill Franks, Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analystics, John Wiley & Sons, 2012.
2. Glenn J. Myatt, Making Sense Of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O‟Reilly, 2011.
3. Jiawei Han, Micheline Kamber ―Data Mining Concepts And Techniques‖, Second Edition, Elsevier, Reprinted 2008.

COURSE OUTCOMES (COs)	
CO1	Understand the concepts of Big Data framework.
CO2	Apply different ways of Data Analysis.
CO3	Apply stream data model.
CO4	Implement different data mining techniques.
CO5	Understand the technologies Map Reduce-Hadoop, MapR, Hive,NoSQL for big data analytics
CO6	Demonstrate visualization techniques.
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1		2	2	3	3					2			3		2
CO2		2	2	3	3					2			3		2
CO3		2	2	3	3					2			3		2
CO4		2	2	3	3							2	3		2
CO5		2	2	3	3							2	3		2
CO6		2	2	3	3							2	3		2
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT6L1	**DATA ANALYTICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Data mining techniques				
	Course Designed by:- Dr.A.Kumarvel, Dept of Information Technology				

OBJECTIVES

- To learn the probability distributions and density estimations to perform analysis of various kinds of data.
- To explore the statistical analysis techniques using Python and R programming languages.

LIST OF EXPERIMENTS:

1. *Install, Configure and Run Hadoop And Hdfs*
2. Implement Word Count / Frequency Programs Using Map reduce
3. Implement a Mr Program That Processes a Weather Dataset
4. Implement Linear and Logistic Regression
5. Implement Svm / Decision Tree Classification Techniques
6. Implement Clustering Techniques
7. Visualize Data Using Any Plotting Framework
8. Implement an Application That Stores Big Data In Hbase / Mongodb / Pig Using Hadoop

REFERENCES:

1. Bill Franks, Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analystics, John Wiley & Sons, 2012.
2. Glenn J. Myatt, Making Sense Of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O‟Reilly, 2011.

COURSE OUTCOMES (COs)	
CO1	Understand single node and multi-node Hadoop Clusters
CO2	Develop Map Reduce programs.
CO3	Implement different data modeling techniques.
CO4	Implement different data mining techniques.
CO5	Experiment the data using plotting framework.
CO6	Demonstrate and execute application tools-Hbase, Mongodb, PIG.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	2		2	3	3					2			3		
CO2	2		2	3	3					2			3		
CO3	2		2	3	3					2			3		
CO4	2		2	3	3							2	3		
CO5	2		2	3	3							2	3		
CO6	2		2	3	3							2	3		
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PCIT6L2	**GRID AND CLOUD COMPUTING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	0	0	4	2
	Prerequisite – Distributed System				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To exposed tool kits for grid and cloud environment.
- To familiar with developing web services/applications in grid framework
- To learn the run virtual machines of different configuration.
- To learn to use hadoop

LIST OF EXPERIMENTS:

1. Develop a new Web Service for Calculator.
2. Develop new OGSA-compliant Web Service.
3. Using Apache Axis develop a Grid Service.
4. Develop applications using Java or C/C++ Grid APIs
5. Develop secured applications using basic security mechanisms available in Globus Toolkit.
6. Develop a Grid portal, where user can submit a job and get the result. Implement it with and without GRAM concept.

COURSE OUTCOMES (COs)	
CO1	Develop a new Web Service for Calculator.
CO2	Execute New OGSA-Compliant Web Service.
CO3	Use Apache Axis and develop a Grid Service.
CO4	Demonstrate Applications using Java Or C/C++ Grid APIs
CO5	Develop Secured Applications using Basic Security Mechanisms available In Globus Toolkit.
CO6	Implement a Grid Portal, where user can submit a job and get the result. Implement it with and without GRAM Concept.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1		2	1	3										1	2
CO2		2	1	3										2	1
CO3		2	1	3										1	2
CO4		2	1	3										1	1

CO5		2	1	3										2	2
CO6		2	1	3										1	2
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

	SOFT SKILL	**L**	**T**	**P**	**C**
U18EEIT6L3	Total Contact Periods:30	0	0	2	1
	Prerequisite – English				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To develop inter personal skills and be an effective goal oriented team player.
- To develop professionals with idealistic, practical and moral values.
- To develop communication and problem solving skills.
- To re-engineer attitude and understand its influence on behavior.

UNIT I SELF ANALYSIS **4**

SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem.

UNIT II CREATIVITY **8**

Out of box thinking, Lateral Thinking

UNIT III ATTITUDE **6**

Factors influencing Attitude, Challenges and lessons from Attitude, Etiquette

UNIT IV MOTIVATION **4**

Factors of motivation, self talk, Intrinsic & Extrinsic Motivators.

UNIT V GOAL SETTING **8**

Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals, Time Management Value of time, Diagnosing Time Management, Weekly Planner to do list, Prioritizing work. Extempore

TEXT BOOK:

1. SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications.

REFERENCE

1. Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
2. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.
3. Thomas A Harris, I am ok, You are ok , New York-Harper and Row, 1972 4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006

COURSE OUTCOMES (COs)	
CO1	Develop inter personal skills and be an effective goal oriented team player.
CO2	Communicate effectively through verbal/oral communication, creative thinking and improve the listening skills.
CO3	Write precise briefs or reports and technical documents.

CO4	Participate in group discussion / meetings / interviews and prepare & deliver presentations
CO5	Set goals to become an effective individual, self-motivation.
CO6	Gain the knowledge of team work; develop Inter-personal relationships, conflict management and leadership quality.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1						1		2	3	3	1	3		2	
CO2						1		2	3	3	1	3		2	
CO3						1		2	3	3	1	3		2	
CO4						1		2	3	3	1	3		2	
CO5						1		2	3	3	1	3		2	
CO6						1		2	3	3	1	3		2	

Category	(EE)
Approval	48th meeting of the Academic Council

U18PCIT701	**WIRELESS NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To Study about Wireless Networks, Protocol Stack and Standards.
- To Study about Fundamentals of 3G Services, Its Protocols and Applications.
- To Study about Evolution of 4G Networks, Its Architecture and Applications.

UNIT-I WIRELESS LAN 9

Introduction-WLAN Technologies: Infrared, UHF Narrowband, Spread Spectrum - IEEE802.11: System Architecture, Protocol Architecture, Physical Layer, MAC Layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband Layer, Link Manager Protocol, Security – IEEE802.16-WIMAX: Physical Layer, MAC, Spectrum Allocation For WIMAX

UNIT II MOBILE NETWORK LAYER 9

Introduction – Mobile IP: IP Packet Delivery, Agent Discovery, Tunneling And Encapsulation, IPV6-Network Layer In The Internet- Mobile IP Session Initiation Protocol – Mobile Ad-Hoc Network: Routing, Destination Sequence Distance Vector, Dynamic Source Routing

UNIT III MOBILE TRANSPORT LAYER 9

TCP Enhancements For Wireless Protocols – Traditional TCP: Congestion Control, Fast Retransmit/Fast Recovery, Implications Of Mobility – Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time Out Freezing, Selective Retransmission, Transaction Oriented TCP – TCP Over 3G Wireless Networks.

UNIT IV WIRELESS WIDE AREA NETWORK 9

Overview Of UTMS Terrestrial Radio Access Network-UMTS Core Network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High Speed Downlink Packet Access (HSDPA)- LTE Network Architecture And Protocol.

UNIT V 4G NETWORKS **9**

Introduction – 4G Vision – 4G Features And Challenges – Applications Of 4G – 4G Technologies: Multicarrier Modulation, Smart Antenna Techniques, OFDM-MIMO Systems, Adaptive Modulation And Coding With Time Slot Scheduler, Cognitive Radio.

TEXT BOOKS:

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg , –Wireless Communications And Networking‖, First Edition, Elsevier 2007.(Unit IV,V)

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, –3G Evolution HSPA And LTE For Mobile Broadband‖, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy Kuri, –Wireless Networking‖, First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, –Modern Wireless Communications‖, First Edition, Pearson Education 2013.

COURSE OUTCOMES (COs)	
CO1	Understand the various protocols and standards of wireless communications.
CO2	Describe about the different wireless WAN architectures.
CO3	Describe the protocols for mobile network layer and routing in mobile ad-hoc network.
CO4	Illustrate the TCP enhancements in mobile transport layer for wireless protocols.
CO5	Demonstrate the latest 3G/4G And Wi-MAX networks and its architecture.
CO6	Explain the 4G technologies and its applications.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	1	1	1	1					2				3	2
CO2	3	2	2	2	1					2				3	3
CO3	2	1	1	1	1					2				3	2
CO4	2	1	1	1	1					2				3	2
CO5	3	2	2	2	1					2				3	3
CO6	2	1	1	1	1					2				3	2
Category	Professional Core (PC)														
Approval	48th meeting of the Academic Council														

U18PEIT011	**COMPUTER VISION**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Mathematics and Computer Fundamentals				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand three-dimensional image analysis techniques and motion analysis
- To study some applications of computer vision algorithms

UNIT I IMAGE PROCESSING FOUNDATIONS

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT II SHAPES AND REGIONS

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III HOUGH TRANSFORM

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT IV 3D VISION AND MOTION

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V APPLICATIONS

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

REFERENCES:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithmsfor analyzing images‖, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
5. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
6. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

COURSE OUTCOMES (COs)	
CO1	Implement fundamental image processing techniques required for computer vision
CO2	Perform shape analysis, Implement boundary tracking techniques, Apply chain codes and other region descriptors
CO3	Apply Hough Transform for line, circle, and ellipse detections
CO4	Apply 3D vision techniques

CO5	Implement motion related techniques
CO6	Develop applications using computer vision techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3	2	1	1	2	3						3	3		
CO2	1	2	1	1	1							3	3		
CO3	3	2	2	3	3				2			2	3		
CO4	3	2	2	3	3				2		2	2	3		
CO5	3	2	3	3	3	3			2		2	3	3		
CO6	3	2	3	3	3	3			2		2	3	3		
Category	Professional Core (PC)														
Approval	49th meeting of the Academic Council														

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U18PEIT012	**ADHOC AND SENSOR NETWORK**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

The student should be made to:

- Understand the design issues in ad hoc and sensor networks.
- Learn the different types of MAC protocols.
- Be familiar with different types of adhoc routing protocols.
- Be exposed to the TCP issues in adhoc networks.
- Learn the architecture and protocols of wireless sensor networks.

UNIT I INTRODUCTION 9

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

UNIT II MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS 9

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

UNIT III ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS 9

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

UNIT IV WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS 9

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

UNIT V WSN ROUTING, LOCALIZATION & QOS 9

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues.

TEXT BOOK: 1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

COURSE OUTCOMES (COs)	
CO1	Describe the concept of network architectures and applications of adhoc and wireless sensor networks.
CO2	Learn the different types of MAC protocols for adhoc wireless networks.
CO3	Design routing protocols for adhoc wireless networks considering protocol design issues.
CO4	Explain the architecture and routing concepts in Wireless Sensor Networks.
CO5	Understand about MAC protocols for Wireless Sensor Networks.
CO6	Illustrate the issues of routing in Wireless Sensor Networks and evaluate the QoS related performance measurements.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2											3		
CO2	3	3	2	1									3		
CO3	3	3	2	1									3		
CO4	3	2											3		
CO5	3	3	2	1	1	3	1					2	3		
CO6	3	3	1	1	1	1	1					1	3		
Category	Professional Core (PC)														
Approval	49th meeting of the Academic Council														

U18PEIT013	**OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Mathematics				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES
To Understand Ethical Issues, Environmental Impact And Acquire Management Skills

UNIT I LINEAR PROGRAMMING 9

Introduction – Formulation of Linear Programming Model-Graphical Solution–Solving LPP Using Simplex Algorithm – Revised Simplex Method.

UNIT II ADVANCES IN LPP 9

Duality Theory - Dual Simplex Method – Sensitivity Analysis–-Transportation Problems–Assignment Problems-Traveling Sales Man Problem -Data Envelopment Analysis

UNIT III NON LINEAR PROGRAMMING 9

Classification of Non Linear Programming – Lagrange Multiplier Method – Karush – Kuhn Tucker Conditions–Reduced Gradient Algorithms–Quadratic Programming Method – Penalty and Barrier Method

UNIT IV INTERIOR POINT METHODS 9

Karmarkar's Algorithm–Projection Scaling Method–Dual Affine Algorithm–Primal Affine Algorithm Barrier Algorithm.

UNIT V DYNAMIC PROGRAMMING 9

Formulation of Multi Stage Decision Problem–Characteristics–Concept Of Sub-Optimization And The Principle Of Optimality–Formulation Of Dynamic Programming–Backward And Forward Recursion– Computational Procedure–Conversion of final Value Problem In To Initial Value Problem.

TEXT BOOK

1. Hillier and Lieberman –Introduction To Operations Research|, TMH, 2000. R.Panneerselvam, –Operations Research|, PHI, 2006
2. Hamdy ATaha, –Operations Research –An Introduction|, Prentice Hall India, 2003.

REFERENCES:

1. Philips, Ravindran and Solberg, –Operations Research|, John Wiley, 2002.
2. Ronald L.Rardin, –Optimization In Operation Research| Pearson Education Pvt. Ltd. New Delhi, 2005.

COURSE OUTCOMES (COs)	
CO1	Understand the basic concepts of linear programming
CO2	Learn the advancements in linear programming techniques
CO3	Describe the different non-linear programming techniques
CO4	Apply interior point methods to solve linear and non-linear convex optimization problems
CO5	Formulate multistage decision problem and dynamic programming.
CO6	Apply optimization techniques for real time problems..

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2	2	2					2			2		3	
CO2	3	2	2	2					2			1		3	
CO3	3	2	2	2					2			2		3	
CO4	3	2	2	2					2			2		3	
CO5	3	2	2	2					2			3		3	
CO6	3	2	2	2					2			2		3	
Category	Professional Core (PC)														
Approval	49th meeting of the Academic Council														

U18PEIT014	**VISUAL ANALYTICS**	**L**	**T**	**P**	**C**

	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Analytics				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

1. To understand how accurately represent voluminous complex data set in web and from other data sources
2. To design and use various methodologies present in data visualization methodologies used for visualizing large data sets
3. To understand the process involved in data visualization and security aspects involved in data visualization
4. Implement the process involved and security issues present in data visualization

UNIT I INTRODUCTION 9

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose- visualization function and tone- visualization design options – Data representation- Data Presentation- Seven stages of data visualization- widgets- data visualization tools.

UNIT II VISUALIZING DATA METHODS 9

Mapping - Time series - Connections and correlations – Scatter plot maps - Trees, Hierarchies and Recursion - Networks and Graphs- Info graphics

UNIT III VISUALIZING DATA PROCESS 9

Acquiring data - Where to Find Data - Tools for Acquiring Data from the Internet- Locating Files for Use with Processing- Loading Text Data- Dealing with Files and Folders- Listing Files in a Folder - Asynchronous Image Downloads- Advanced Web Techniques- Using a Database-Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues- Text Is Best- Text Markup Languages- Regular Expressions (regexps)- Grammars and BNF Notation-Compressed Data- Vectors and Geometry- Binary Data Formats- Advanced Detective Work.

UNIT IV INTERACTIVE DATA VISUALIZATION 9

Drawing with data – Scales – Axes – Updates- Transition and Motion – Interactivity - Layouts – Geo mapping – Exporting, Framework – T3- js- tablo.

UNIT V SECURITY DATA VISUALIZATION 9

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems - Creating security visualization system.

TEXT BOOK:

1. Scott Murray, –Interactive data visualization for the web‖, O"Reilly Media, Inc., 2013.
2. Ben Fry, –Visualizing Data‖, O"Reilly Media, Inc., 2007.

REFERENCES:

1. Greg Conti, –Security Data Visualization: Graphical Techniques for Network Analysis‖, No Starch Press Inc, 2007.

COURSE OUTCOMES (COs)	
CO1	Understand the purpose of visualization in general and visual analytics in particular

CO2	Describe the collection of visualization and analysis techniques
CO3	Explain the concepts and techniques for visualizing data process
CO4	Develop applications using interactive data visualization tools
CO5	The Students will be able to understand the techniques for Attacking and defending visualization systems
CO6	Identifying the vulnerabilities and attacks and thus create security visualization system.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1			1	2		1			2		1	3	2		2
CO2	2	3	1	2		1			2	1		3	2		2
CO3	2	3	1	2		1			2	1		3	2		2
CO4	2	3	1	2		1			2	1		3	2		2
CO5	2	3	1	2		1			2	2	1	3	2		2
CO6	2	3	1	2		1			2	2	1		2		2
Category	Professional Core (PC)														
Approval	49th meeting of the Academic Council														

U18PEIT015	**HEALTH INFORMATICS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Mastery of a high-level programming language such as C++ or Java				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES
To learn about the historical information of hospitality and recent trends in the Hospital information system.

UNIT-I BIOMEDICAL INFORMATION SYSTEM 9
Historical Highlights of health care information system-Biomedical information system-problems and pitfalls-History and evolution of Electronic resources, Multimedia components

UNIT-II OVERVIEW OF COMPUTER HARDWARE 9
Motherboard and its logic-Memory and I/O interfacing/memory and input output mapping-I/O peripherals and Add-on cards.

UNIT-III HOSPITAL INFORMATION SYSTEM 9
Concept of HIS its position in hospital-introduction of a computerized HIS Automation of medical record-cost and Benefits of HIS-Modems and Networking in Hospitals.

UNIT-IV VISUAL PROGRAMMING AND MULTIMEDIA INFORMATION 9
Visual Basic Principles and Programming-Design, Production and Testing of Multimedia based HIS.

UNIT-IV INTEGRATED MEDICAL INFORMATION SYSTEM 9

Integration of inter and intra hospital information system. Role of expert systems-web based Multimedia information system-Video-conferencing-PowerPoint Presentation.

TEXT BOOK:

1. R.D.Lele ―Computer in Medicine‖ Tata McGraw Hill, Newyork, 1999.

REFERENCES:

1. S.K.Chauhan ―PC Organisation‖, S.K.Kataria and Sons, Delhi 2000.
2. Harold Sackamn ―Bio Medical Information Technology‖, Academic Press, Newyork.

COURSE OUTCOMES (COs)	
CO1	Gain Knowledge about the historical highlights of health care and biomedical information system.
CO2	Describe the overview of computer hardware used in the health care Information system
CO3	Learn about the concept of hospital Information system and automating the medical records.
CO4	Develop skills in the concepts of visual programming.
CO5	Design and test the web based multimedia based health care information system
CO6	Acquire the skills for integrating inter and intra hospital information system.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2		1	2		1			2	2	2	3	3		
CO2	2		1	2		1			2	2	2	3	3		
CO3	2		1	2		1			2	2	2	3	3		
CO4	2	3	1	2		1			2	2	2	3	3		
CO5	2	3	1	2		1			2	2	2	3	3		
CO6	2		1	2		1			2	2	2	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT016	**SOFTWARE TESTING**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Software Engineering				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

To Learn the design of test cases and to be familiar with test management and test automation techniques.

UNIT I INTRODUCTION 9

Testing as an Engineering Activity – Testing as a Process – Testing axioms – Basic definitions – Software Testing Principles – The Tester‟s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support of Developing a Defect Repository – Defect Prevention strategies.

UNIT II TEST CASE DESIGN 9

Test case Design Strategies – Using Black Bod Approach to Test Case Design – Random Testing – Requirements based testing – Boundary Value Analysis – Equivalence Class Partitioning – State-based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Evaluating Test Adequacy Criteria.

UNIT III LEVELS OF TESTING 9

The need for Levers of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing – Compatibility testing – Testing the documentation – Website testing.

UNIT IV TEST MANAGEMENT 9

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group.

UNIT V TEST AUTOMATION 9

Software test automation – skill needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.

TEXT BOOKS:

1. Srinivasan Desikan And Gopalaswamy Ramesh, ―Software Testing – Principles And Practices‖, Pearson Education, 2006.
2. Ron Patton, ―Software Testing‖, Second Edition, Sams Publishing, Pearson Education, 2007.

REFERENCES:

1. Ilene Burnstein, ―Practical Software Testing‖, Springer International Edition, 2003.
2. Edward Kit,‖ Software Testing In The Real World – Improving The Process‖, Pearson Education, 1995.
3. Boris Beizer,‖ Software Testing Techniques‖ – 2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, ―Foundations Of Software Testing _ Fundamental Algorithms And Techniques‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

COURSE OUTCOMES (Cos)	
CO1	Design test cases suitable for a software development for different domains.
CO2	Apply different test case design strategies.
CO3	Execute various levels of testing.
CO4	Document the test design, test plan, test reports and project management.

CO5	Acquire the skills required for a test specialist.
CO6	Describe the concepts of software test automation, test metrics and measurements.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3		2						3		1		3		
CO2	3		2			1			3		1	1	3		
CO3	3		2		1				3	2	1	2	3		
CO4	3		2	1					3	2	1	2	3		
CO5	3		2			1			3	2	1	3	3		
CO6	3		2	1	1	1			3	2	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT021	**HIGH SPEED NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods:45	3	0	0	3
	Prerequisite – Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- Students will be provided with an up-to-date survey of developments in High Speed Networks.
- Enable the students to know techniques involved to support real-time traffic and congestion control.
- Students will be provided with different levels of quality of service (Q.S) to different applications.

UNIT 1 HIGH SPEED NETWORKS 9

Frame Relay Networks - Asynchronous transfer mode - ATM Protocol Architecture, ATM logical Connection, ATM Cell - ATM Service Categories - AAL. High Speed LAN‘s: Fast Ethernet, Gigabit Ethernet, Fibre Channel - Wireless LAN‘s: applications, requirements - Architecture of 802.11

UNIT 2 CONGESTION AND TRAFFIC MANAGEMENT 9

Queuing Analysis - Queuing Models - Single Server Queues - Effects of Congestion - Congestion Control - Traffic Management - Congestion Control in Packet Switching Networks - Frame Relay Congestion Control.

UNIT 3 TCP AND ATM CONGESTION CONTROL 9

TCP Flow control - TCP Congestion Control - Retransmission - Timer Management - Exponential RTO backoff - KARN‘s Algorithm - Window management - Performance of TCP over ATM.Traffic and Congestion control in ATM - Requirements - Attributes - Traffic Management Frame work, Traffic Control - ABR traffic Management - ABR rate control, RM cell formats, ABR Capacity allocations - GFR traffic management.

UNIT 4 INTEGRATED AND DIFFERENTIATED SERVICES 9

Integrated Services Architecture - Approach, Components, Services - Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ - Random Early Detection, Differentiated Services.

UNIT 5 PROTOCOLS FOR QOS SUPPORT RSVP 9

Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms - Multiprotocol Label Switching - Operations, Label Stacking, Protocol details - RTP - Protocol Architecture, Data Transfer Protocol, RTCP.

TEXTBOOK

1. William Stallings, ―High Speed Networks And Internet‖, Pearson Education, Second Edition, 2002. [Chapter - 4-6, 8, 10, 12, 13, 17,18]
2. Warland & Pravin Varaiya, –High Performance Communication Networks‖, Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.

REFERENCE BOOKS

1. Irvan Pepelnjk, Jim Guichard and Jeff Apcar, –MPLS and VPN architecture‖, Cisco Press, Volume 1 and 2, 2003

COURSE OUTCOMES (COs)	
CO1	Understand the basic concepts of asynchronous transfer mode and wireless LAN
CO2	Analyze the concept of congestion control and traffic management.
CO3	Study about TCP and ATM congestion control
CO4	Understand techniques involved to support real-time traffic and congestion control.
CO5	Understand different levels of Quality of Service (QoS) to different applications.
CO6	Implement protocols for QoS Support RSVP

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	3	1	2		1			2		1	3	3		
CO2	2	3	1	2		1			2	1		3	3		
CO3	2	3	1	2		1			2	1		3	3		
CO4	2	3	1	2		1			2	1		3	3		
CO5	2	3	1	2		1			2		1	3	3		
CO6	2	3	1	2		1			2	1	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT022	**NATURAL LANGUAGE PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

This course is designed to introduce some of the problems and solutions of NLP, and their relation to linguistics and statistics.

UNIT-I INTRODUCTION 9

Introduction - The issues arid difficulties in natural language processing -Linguistics and computational linguistics - Language under- standing and generation - Understanding of

spoken, written and textual information.

UNIT-II PARSING AND GRAMMAR 9

Syntactic Parsing - English grammar - Structure of the sentence - words and organization of the lexicon - Context free and context sensitive grammar -Transformational grammar-The role of syntax analysis in semantics ATN's - Definite clause grammar and WASP parsers.

UNIT-III INTERPRETATION 9

Semantic interpretation - The conceptual dependency model for semantic representation - Semantic network - Frames and scripts - Semantics in the lexicon.

UNIT-IV SEMANTIC NETWORK 9

Discourses interpretation - The interconnections between pragmatics -Pragmatics in discourse analysis-Speech acts plan-based Theory of speech acts - Semantic network - Frame and scripts - Semantics in the lexicon.

UNIT-V CASE STUDY 9

Generation - Strategies for generation - Planning English referring expressions -KING, a Natural language generation systems.Typical systems - ELIZA - Baseball - GLJS - PARRY - LADDER - SOPGIE & POET current trends in NLP.

TEXTBOOK

1. James Alien Benjamin Cummings, ―Natural language understanding‖, 2nd Edition 1995. Benjamin/Cummins Publishing Company.
2. Natural Language Processing by Ela kumar,2011

REFERENCE BOOK

1 Windgrad, –Language as a Cognitive Process; Syntax‖, Addison Wesley Publication.
2 F Popov, –Talking with Computer in Natural Language‖, Springer-Verlag, 1986.

COURSE OUTCOMES (COs)	
CO1	Outline Natural Language Processing tasks in syntax, semantics, and pragmatics.
CO2	Explain Morphology and Part of Speech Tagging.
CO3	Describe how syntax parsing techniques can be used.
CO4	Explain the use of semantic analysis methods.
CO5	Relate a few applications of Natural Language Processing.
CO6	Simulate elementary case studies of NLP in Syntactical and Semantical Aspects

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	2	2		
CO2	2	3	1	2		1			2	1		2	2		
CO3	2	3	1	2		1			2	1		2	2		1
CO4	2		1	2		1			2	1		2	2		1
CO5	2		1	2		1			2		1	2	2		1
CO6	2	1	1	2		1			2	1	1	2	2		1
Category	Professional Electives(PE)														

Approval	49th meeting of the Academic Council

U18PEIT023	**SOCIAL NETWORK ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Computer networks and data mining				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks

UNIT I INTRODUCTION 9

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION 9

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 9

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT IV PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES 9

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based

representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

TEXT BOOKS:

1. Peter Mika, ―Social Networks and the Semantic Web‖, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

REFERENCES:

1. Guandong Xu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, ―Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, ―The Social Semantic Web‖, Springer, 2009.

COURSE OUTCOMES (COs)	
CO1	Develop semantic web related applications.
CO2	Represent knowledge using ontology.
CO3	Extract and mine communities in web social networks
CO4	Predict human behavior in social web and related communities
CO5	Analyze the security issues and privacy policies in Social networks
CO6	Visualize social networks in real time applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	3	2	2		1		2		1	1		3		
CO2	2	3	2	2		1		2		1			3		
CO3	2	3	2	2		1		2	2	1			3		
CO4	2	3	2	2		1		2	2	1		3	3		
CO5	2	3	2	2		1		2	2	1	1	3	3		
CO6	2	3	2	2		1		2	2	1	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT024	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Data mining techniques				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

1. To understand the role of business analytics within an organization.
2. To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. Use advanced analytical tools to analyze complex problems under uncertainty.
4. Manage business processes using analytical and management tools.

UNIT - I INTRODUCTION 9

Introduction to Business Analytics - Business View of Information TechnologyApplications - Key purpose of using IT in Business - Characteristics of Internet Ready IT Applications - Information Users and their Requirements- Types of digital data - Introduction to OLTP and OLAP.

UNIT - II BUSINESS INTELLIGENCE 9

Using Analytical Information for Decision Support - Definition and examples in business intelligence - Evolution of BI and Role of DSS- EIS- MIS and Digital Dashboards - BI Definition and Concepts - BI Component Framework - Purpose of BI - Business Intelligence Applications - BI Roles and Applications.

UNIT - III DATA MODELING 9

Basic Data Integration - Data Warehouse -p Data Integration Technologies - Data Quality - Data Profiling - Multidimensional Data Modelling - Inrtoduction - Data Modelling Techniques - Fact table - Dimension table - typical dimensional Models - Dimensional Modelling Life Cycle – Measure- Metrics and Performance Management.

UNIT - IV STATISTICS AND ALGORITHMS 9

Basic of Enterprise Reporting - Understanding Statistics - Role of Statistics in Analytics - Data, Data Description and Summarization - Statistical Tests - Understanding Hypothesis and t-test- Correlation Analysis - Regression - The F-Test - Time Series analysis - Application of Analytics - Data mining Algorithms - Association Rule Mining - k-Mean Clustering - Decision Tree.

UNIT -V CASE STUDIES 9

Segmenting bank customer transaction histories - Association analysis of Web services data - Creating a simple credit risk model from consumer loan data - Predicting university enrolment management

TEXT BOOKS:

1. Fundamentals of Business Analytics, R.N. Prasad, Seema Acharys, 2nd Edition, Wiley India Pvt Ltd., 2016.
2. Business Analytics, James R. Evans, 2nd Edition, Pearson Education Limited- 12-Jan-2016

REFERENCES:

1. Business Analytics an Application focus, Purba Halady Rao PHI Learning Pvt. Ltd - 2013
2. Business Analytics: Data Analysis & Decision Making - Standalone , S. Christian Albright , Wayne L. Winston- Cengage Learning, Business & Economics-31-Mar-2016
3. Competing on Analytics: Updated, with a New Introduction: The New Science of Winning, Thomas H. Davenport, Jeanne G. Harris - Harvard Business Review Press, 2017.

COURSE OUTCOMES (COs)

CO1	Understand the concept and role of analytics in business.
CO2	Use business intelligence to formulate and solve business problems and to support managerial decision making.
CO3	Describe the data integration and data modeling techniques.
CO4	Learn the concept of enterprise reporting, statistical techniques and data mining algorithms in analytics,
CO5	Implement analytics in real time applications-bank management, general management, marketing, finance, operations and supply chain management.
CO6	Apply analytic principles and techniques to a business problem

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	2	3	2	2		1			2		1	3	3		2
CO2	2	3	2	2					2	1		3	3		2
CO3	2	3	2	2					2	1		3	3		2
CO4	2	3	2	2					2	1		3	3		2
CO5	2	3	2	2		1			2	1	2	3	3		2
CO6	2	3	2	2		1			2	1	2	3	3		2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

18PEIT025	**MOBILE APPLICATION DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Mobile communication				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn the characteristics of mobile applications.
- To learn about the intricacies of UI required by mobile applications.
- To study about the design aspects of mobile application.

UNIT I INTRODUCTION 9

Mobile Applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Software Engineering – Frameworks and Tools – Mobile devices Profiles.

UNIT II USER INTERFACE 9

Generic UI Development – VUIs and Mobile Applications – Text to Speech techniques – Designing the right UI – Multimodal and Multichannel UI – Gesture based UIs – Screen Elements and Layouts – Voice XML – Java API.

UNIT III APPLICATION DESIGN 9

Memory Management – Design patterns for limited memory – Work flow for Application Development – Techniques for composing Applications – Dynamic Linking – Plug ins and rules of thumb for using DLLs – Concurrency and Resource Management – Look and feel.

UNIT IV APPLICATION DEVELOPMENT 9

Intents and Services – Storing and Retrieving data – Communication via the Web – Notification and Alarms – Graphics and Multimedia – Telephony – Location based services – Packaging

and Deployment – Security and Hacking.

UNIT V TOOLS 9

Google Android Platform – Eclipse Simulator – Android Application Architecture – Event based programming – Apple iPhone Platform – UI tool kit interfaces – Event handling and Graphics services – Layer Animation.

TEXT BOOKS:

1. Share Conder, Lauren Darcey, "Android Wireless Application Development" Pearson 3rd Edition.
2. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura,―Programming Android‖, O"Reilly, 2011.

REFERENCES:

1. Professional mobile Application Development paperback,2012 Jeff Mcherter (Author),Scott Gowell (Author), Wiley India Private Limited
2. Reto Meier, Wrox Wiley, ―Professional Android 2 Application Development‖, 2010.
3. Alasdair Allan, ―iPhone Programming‖, O"Reilly, 2010.

COURSE OUTCOMES (COs)	
CO1	Explain the features and challenges of mobile devices, native app development frameworks, hybrid app development frameworks
CO2	Learn the intricacies of user interfaces and implement the user interfaces for mobile applications.
CO3	Design the mobile applications considering the resource constraints in mobile devices.
CO4	Design a secure mobile application based on user requirements
CO5	Select appropriate framework and tool for developing mobile applications based on the problem requirements
CO6	Design and develop mobile applications for societal and environmental problems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2	2	1		1	2			3				3		
CO2	2	2	1		1	2			3	2			3		
CO3	2	2	1		1	2			3	2	3	3	3		
CO4	2	2	1		1	2			3	2	3	3	3		
CO5	2	2	1		1	2			3	2	3	3	3		
CO6	2	2	1		1	2			3	2	3	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

	WAVELET TRANSFORMS AND ITS APPLICATION	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3

U18PEIT026	Prerequisite – Mobile communication
	Course Designed by:- Dept of Information Technology

OBJECTIVES

To in

troduce the fundamentals concepts of wavelet transforms.

- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I INTRODUCTION TO WAVELETS 9

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM 9

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN 9

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES 9

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V WAVELET APPLICATIONS 9

Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, _Introduction to wavelets and wavelet transform,,, Prentice Hall, 1998.
2. G.Strang and T.Nguyen, _Wavelet and filter banks,,, Wesley and Cambridge Press.
3. M.Vetterli and J. Kovacevic, _Wavelets and sub band coding,,, Prentice Hall, 1995.
4. Metin Akay, _Time frequency and wavelets in biomedical signal processing,,, Wiley-IEEE Press, October 1997.
5. P.P.Vaidyanathan, _Multi rate systems and filter banks,,, Prentice Hall 1993 4. Raguveer m Rao & Ajith S. Bopardikar, _Wavelet transforms – Introduction to theory and applications,,, Addison Wesley, 1998
6. S.Mallet, _A Wavelet tour of signal processing,,, Academic Press 1998

COURSE OUTCOMES (COs)	
CO1	Understand the basic concepts of wavelet and its types

CO2	Analyze multi resolution concepts and discrete wavelet transform.
CO3	Design the different wavelet system.
CO4	Describe the properties and applications of wavelet families.
CO5	Analysis of phonocardiogram signals, EEG signals, Speech enhancement for hearing aids and de-noising technique.
CO6	Implement wavelet applications in real time.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	3		
CO2	2	3							2	1		3	3		
CO3	2	3							2	1		3	3		
CO4	2	3	1	2					2	1		3	3		
CO5	2	3	1	2		1			2		1	3	3		
CO6	2	3	1	2		1			2	1	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

18PEIT031	**CYBERFORENSICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite –Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn computer forensics
- To become familiar with forensics tools
- To learn to analyze and validate forensics data

UNIT I INTRODUCTION TO COMPUTER FORENSICS 9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II EVIDENCE COLLECTION AND FORENSICS TOOLS 9

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III ANALYSIS AND VALIDATION 9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV ETHICAL HACKING 9

Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNIT V ETHICAL HACKING IN WEB 9

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2. CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.

REFERENCES

1. John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2. MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3. AnkitFadia ― Ethical Hacking Second Edition, Macmillan India Ltd, 2006

COURSE OUTCOMES (COs)	
CO1	Explain computer forensics and its techniques
CO2	Learn about evidence collection and applying forensic tools for crime investigations.
CO3	Analyze and validate forensics data.
CO4	Explore the fundamentals of ethical hacking
CO5	Execute penetration technique using standard hacking tools in an ethical manner
CO6	Learn about reconnaissance, protocols, windows hacking, hacking web technologies, wireless networks and mobile platforms

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	2		1		2				2				2		
CO2	2	2	1	2	2	2		2	2			3	2		
CO3	2	2	1	2	2	2		2	2			3	2		
CO4	2		1		2				2				2		
CO5	2	2	1	2	2	2		2	2			3	2		
CO6	2	2	1	2	2	2			2			3	2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT033	**APPLICATIONS OF DATAMINING**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Data Warehousing and Data mining Techniques				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To learn how to prepare, process, understand, analyze and present the data.
- To analyze the problem and Implement different techniques.
- To Evaluate and Refine them for analyze the problem.
- To implement data mining tools such as R/ Weka

UNIT - I INTRODUCTION 9

Introduction to Data and Big Data -Data Types and Data Qualities - Sampling, Sample Sets

and Data Population - Statistical Inference and Introduction to Supervised and Unsupervised Learning method - Data Mining Goals - Stages of the Data Mining Process - Data Mining Techniques - Introduction to Data Mining Tools - R and WEKA

UNIT - II DATA MINING KNOWLEDGE REPRESENTATION 9

Task relevant data- Background knowledge -Interestingness measure-Representing input data and output knowledge - Data Visualization- Basic concepts - Visualization techniques - Experiments with Weka/R using visualization- Attribute-oriented analysis -Attribute generalization- Attribute relevance -Class comparison -Statistical measures- Experiments with Weka / R using filters and statistics

UNIT- III CLASSIFICATION 9

Basic learning/mining tasks - Inferring rudimentary rules: 1R algorithm - Covering rules - Introduction to Decision Trees -Rule Based Classifier - Experiments with Weka/R using decision trees, rules -The prediction task - Statistical (Bayesian) classification - Bayesian networks -Instance-based methods (nearest neighbor)-Linear models -Experiments with Weka/R using Prediction

UNIT - IV CLUSTERING ANALYSIS 9

Clustering Analysis - Basic issues in clustering - conceptual clustering system: Cluster/2 - Partitioning methods: k-means, expectation maximization (EM) - Hierarchical methods: distance-based agglomerative and divisible clustering - Conceptual clustering: Cobweb - Experiments with Weka/R using k-means, EM, Cobweb -Association rules - Generating item sets and rules efficiently-Correlation analysis -Experiments with Weka/R - mining association rules

UNIT - V CASE STUDY 9

Training and testing - Estimating classifier accuracy (holdout, cross-validation, leave-one-out) - Combining multiple models (bagging, boosting, stacking) - Experiments with Weka/R for training and testing- Mining Real data - Preprocessing data -Applying various data mining techniques to create a comprehensive and accurate model of the data -Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing).

TEXT BOOKS:

1. Data Mining: Concepts and Techniques, 3rd ed. by Jiawei Han, Micheline Kamber and Jian Pei, Elsevier, eBook ISBN: 9780123814807, June 2011
2. Sumathi, S., Sivanandam, S.N. , Introduction to Data Mining and its Applications, ISBN 978-3-540-34351-6
3. Bater Makhabel , Learning Data Mining with R, Packt Publishing Ltd, 31 Jan 2015

REFERENCES:

1. Kevin Patrick Murphy, Machine Learning: a Probabilistic Perspective, 2012 http://www.cs.ubc.ca/~murphyk/MLbook/
2. P.-N. Tan, M. Steinbach and V. Kumar, Introduction to Data Mining, Wiley, 2005
3. Yanchang Zhao , Yonghua Cen ,Data Mining Applications with R, 30 Dec 2013
4. http://web.engr.illinois.edu/~hanj/bk3/
5. Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group–2008.

COURSE OUTCOMES (COs)	
CO1	Understand different data mining tasks and the functionalities of Weka/R tools.

CO2	Explain knowledge representation and metrics.
CO3	Understand and implement the different Classification techniques.
CO4	Demonstrate and implement unsupervised learning techniques.
CO5	Understand ensemble models.
CO6	Demonstrate case studies for analyzing the performance of the data models.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3	3	3	2					2	2	2		3	
CO2	3		2	3	3					2		2		3	
CO3		1	3				`			2	2	2		3	
CO4	3	2		2	3					2	2	2		3	
CO5	2	2	2		2					2		2		3	
CO6		1	2	3	3					2	2	2		3	
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT032	**VIRTUAL AND AUGMENTED REALITY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –C/C++, Data Structures,Computer Graphics				
	Course Designed by:- Dept of Information Technology				

OOBJECTIVES

- To learn Virtual reality; multiple modal interaction, visual-auditory-haptic, interaction inmersion
- To learn imagination, visual computation and environmental modeling; geometric behavior and physically based simulation
- To understand the management of large scale environment, VR development tools, augmented reality, mixed reality, digital entertainment.

UNIT- 1 Introduction of Virtual Reality **9**

Fundamental Concept and Components of Virtual Reality Primary Features and Present Development on Virtual Reality

UNIT- II Multiple Modals of Input and Output Interface in Virtual Reality **9**

Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual / Auditory / Haptic Devices

UNIT- III Visual Computation in Virtual Reality **9**

Fundamentals of Computer Graphics Software and Hardware Technology on Stereoscopic Display Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering

UNIT- IV Environment Modeling in Virtual Reality **9**

Geometric Modeling, Behavior Simulation, Physically Based Simulation Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object

UNIT- V Grasp Introduction of Augmented Reality (AR) **9**

System Structure of Augmented Reality Key Technology in AR Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc

TEXT BOOK

1. Bush, V. (1945) As We May Think, The Atlantic.
2. Feiner, S.K. (2002) Augmented Reality: A New Way of Seeing, Scientific American, 286(4), pp. 34-41.
3. Billinghurst, M., Poupyrev, I., Kato, H., May, R. (2000) Mixing Realities in Shared Space: An Augmented Reality Interface for Collaborative Computing, Proc. of the IEEE Int'l Conf. on Multimedia and Expo (ICME), pp. 1641-1644.
4. Uchiyama H., Saito H. (2011) Random Dot Markers, Proc. of IEEE VR 2011, pp. 35-38.

COURSE OUTCOMES (COs)	
CO1	Understand the basic concept and framework of virtual reality.
CO2	Describe the multiple modals of input and output interface in virtual reality.
CO3	Explain the fundamentals of computer graphics.
CO4	Apply display advanced techniques in computer graphics.
CO5	Explore about the environment modeling in virtual reality.
CO6	Learn about the fundamentals of Augmented Reality and implement software development tools in Virtual Reality

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3		3	
CO2	2	3	1	2		1			2	1		3		3	
CO3	2	3	1	2		1			2	1		3		3	
CO4	2		1	2		1			2	1		3		3	
CO5	2		1	2		1			2		1	3		3	
CO6	2	3	1	2		1			2	1	1	3		3	
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT034	**MACHINE LEARNING TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Principles of Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To understand the theoretical and practical aspects of Probabilistic Graphical Models.
- To understand probabilistic graphical models.
- To understand sample complexity analysis.

UNIT I INTRODUCTION **9**

Machine Learning - Machine Learning Foundations –Overview – Design of a Learning system - Types of machine learning –Applications Mathematical foundations of machine learning - random variables and probabilities - Probability Theory – Probability distributions -Decision Theory- Bayes Decision Theory - Information Theory.

UNIT II SUPERVISED LEARNING 9

Linear Models for Regression - Linear Models for Classification – Naïve Bayes - Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- egression Trees - Pruning. Neural Networks -Feed-forward Network Functions - Back- propagation. Support vector machines - Ensemble methods- Bagging- Boosting.

UNIT III UNSUPERVISED LEARNING 9

Clustering- K-means - EM Algorithm- Mixtures of Gaussians. The Curse of Dimensionality - Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis.

UNIT IV PROBABILISTIC GRAPHICAL MODELS 9

Graphical Models - Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – Learning- Generalization - Hidden Markov Models - Conditional random fields(CRFs)

UNIT V ADVANCED LEARNING 9

Sampling – Basic sampling methods – Monte Carlo - Reinforcement Learning – K - Armed Bandit - Elements - Model-Based Learning- Value Iteration- Policy Iteration. Temporal Difference Learning- Exploration Strategies- Deterministic and Non-deterministic Rewards and Actions Computational Learning Theory - Mistake bound analysis, sample complexity analysis- VC dimension. Occam learning- accuracy and confidence boosting

TEXT BOOK

1. Christopher Bishop, ‒Pattern Recognition and Machine Learning| Springer, 2007.
2. Kevin P. Murphy, ‒Machine Learning: A Probabilistic Perspective|, MIT Press, 2012.
3. Ethem Alpaydin, ‒Introduction to Machine Learning|, MIT Press, Third Edition, 2014.

REFERENCES:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, Second Edition, 2011.

COURSE OUTCOMES (COs)	
CO1	Understand the fundamentals and concept of Machine learning.
CO2	Apply probabilistic techniques for real time application in uncertain environment.
CO3	Explain the concepts of supervised and unsupervised learning techniques.
CO4	Design and implement probabilistic graphical models in real time applications.
CO5	Use machine learning tools to implement typical clustering algorithms for different types of applications.
CO6	Explore the different advanced learning techniques.
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1			1	2		1			2		1	3	3		2
CO2	2	3	1	2		1			2	1		3	3		2
CO3	2	3	1	2		1			2	1		3	3		2
CO4	2	3	1	2		1			2	1	2	3	3		2
CO5	2	3	1	2		1			2	1	2	3	3		2
CO6	2	3	1	2		1			2	1	2	3	3		2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT035	**BIO-INSPIRED COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Principles of Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- Learn evolutionary theory and algorithms
- Understand Cellular Automata and artificial life
- Learn artificial neural systems and related learning algorithms

UNIT I EVOLUTIONARY AND CELLULAR SYSTEMS 9

Foundations of evolutionary theory – Genotype – artificial evolution – genetic representations – initial population – fitness functions – selection and reproduction – genetic operators – evolutionary measures – evolutionary algorithms – evolutionary electronics – evolutionary algorithm case study Cellular systems – cellular automata – modeling with cellular systems – other cellular systems – computation with cellular systems – artificial life – analysis and synthesis of cellular systems

UNIT II NEURAL SYSTEMS 9

Biological nervous systems – artificial neural networks – neuron models – architecture – signal encoding – synaptic plasticity – unsupervised learning – supervised learning – reinforcement learning – evolution of neural networks – hybrid neural systems – case study

UNIT III DEVELOPMENTAL AND IMMUNE SYSTEMS 9

Rewriting systems – synthesis of developmental systems – evolutionary rewriting systems – evolutionary developmental programs Biological immune systems – lessons for artificial immune systems – algorithms and applications – shape space – negative selection algorithm – clonal selection algorithm - examples

UNIT IV BEHAVIORAL SYSTEMS 9

Behavior is cognitive science – behavior in AI – behavior based robotics – biological inspiration for robots – robots as biological models – robot learning – evolution of behavioral systems – learning in behavioral systems – co-evolution of body and control – towards self reproduction – simulation and reality

UNIT V COLLECTIVE SYSTEMS 9

Biological self-organization – Particle Swarm Optimization (PSO) – ant colony optimization (ACO) – swarm robotics – co-evolutionary dynamics – artificial evolution of competing systems – artificial evolution of cooperation – case study

TEXT BOOK:

1. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence", MIT Press, 2008.
2. F. Neumann and C. Witt, –Bioinspired Computation in combinatorial optimization: Algorithms and their computational complexity‖, Springer, 2010.
3. A. E. Elben and J. E. Smith, –Introduction to Evolutionary Computing‖, Springer, 2010.

REFERENCES:

1. D. E. Goldberg, –Genetic algorithms in search, optimization, and machine learning‖, Addison- Wesley, 1989.
2. Simon O. Haykin, ―Neural Networks and Learning Machines‖, Third Edition, Prentice Hall, 2008.

COURSE OUTCOMES (COs)	
CO1	Implement and apply evolutionary algorithms.
CO2	Explain cellular automata and artificial life.
CO3	Implement and apply neural systems.
CO4	Explain developmental and artificial immune systems.
CO5	Describe behavioral systems and to implement in collective intelligence systems.
CO6	Design bio inspired solutions for real world problems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	2		
CO2	2	3	1	2		1			2	1		3	2		
CO3	2	3	1	2		1			2	1		3	2		
CO4	2		1	2		1			2	1		3	2		
CO5	2		1	2		1			2	1	1	3	2		
CO6	2	3	1	2		1			2	1	1	3	2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT036	**SOFTWARE CONFIGURATION MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Software Engineering Methodologies				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To Introduce the basic concepts of software configuration management
- To learn the importance of SCM in software development
- To understand the different SCM phases and activities, branching, release management, configuration management roles.

UNIT 1 INTRODUCTION 9

Introduction to software configuration Management, SCM and Process Improvement, Measurements and Metrics – Benefits of SCM – Configuration Identification – Configuration Change control – Implementing SCM in the Organization – Project Management in CM Environment- Software Scope- Project Estimation – Risk Management Strategies.

UNIT II THE DoD CM PROCESS MODEL 9

CM Benefits, Risks, CM Life-Cycle Management and Planning- Relation to system engineering process – Implementing the CM process – measuring and Evaluating the CM process.

UNIT III CONFIGURATION IDENTIFICATION 9

Product structure – configuration items – configuration documentation – specification types – software requirement analysis and design – software architecture and design – software integration and qualification – configuration base line concept.

UNIT IV CONFIGURATION CONTROL 9

The process of configuration control – Configuration status accounting – Typical CSA information over the acquisition program – Life cycle - Configuration status accounting process Evaluation.

UNIT V CONFIGURATION VERIFICATION AND AUDITING 9

Configuration identification – the effective documentation of the system – Methods and standards – Generating documentation – configuration verification and Audit – Concepts and principles – configuration verification – configuration audit – application of audits.

TEXT BOOK:

1. Software Configuration Management, Jessica Keyes , Auerbach Publication , 2004

REFERENCES:

1. Enterprise Software Configuration Management Solutions for Distributed and System z, Paolo Cravino, David Lawrence, Antonio Alonso, López Brandt Onorato Zhenhua (Eric) Shen, January 2009

COURSE OUTCOMES (COs)	
CO1	Understand the concepts and principles of software configuration management.
CO2	Explain about configuration Management and planning.
CO3	Define the relation between software configuration management and the software development.
CO4	Select configuration items at appropriate levels of the product structure
CO5	Describe the configuration management activities like control, status accounting, auditing and verification.
CO6	Implement technical Software Configuration Management System in real time.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						3		1		3		
CO2	3		2			1			3		1	1	3		
CO3	3		2		1				3	2	1	2	3		
CO4	3		2	1					3	2	1	2	3		
CO5	3		2	1		1			3		1	3	3		

CO6	3		2	1	1	1			3	2	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT041	**CLOUD COMPUTING AND SECURITY**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Data Communication and Computer Networks				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT II CLOUD ENABLING TECHNOLOGIES 10

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 8

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 10

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 8

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, ―Distributed and Cloud Computing, From Parallel Processing to the Internet of Things‖, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, ‐Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, ‐Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

COURSE OUTCOMES (COs)	
CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2	Learn the key and enabling technologies that help in the development of cloud.
CO3	Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
CO4	Explain the core issues of cloud computing such as resource management and security.
CO5	Be able to install and use current cloud technologies.
CO6	Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	2		
CO2	2	3	1	2		1			2	1		3	2		
CO3	2	3	1	2		1			2	1		3	2		
CO4	2		1	2		1			2	1		3	2		
CO5	2		1	2		1			2	1	1	3	2		
CO6	2	3	1	2		1			2	1	1	3	2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT042	**MULTI AGENT SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Principles of Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- Taxonomy of agent architectures, formal languages for multi-agent systems specification, languages and schemes for knowledge representation, formal languages

and models for modeling of agent and environment behavior, agent communication languages and associated semantic models.

- Basic inter-agent interaction patterns and coordination of cooperative and antagonistic agents. Coordination techniques: organizational structure, contracting, multi-agent planning and negotiation.
- Application of multi-agent systems in computer and robot vision, decision support systems, electronic commerce, robotics, and simulation of societies.

UNIT-I INTRODUCTION 9

Intelligent Agents-Deductive reasoning Agents – Agents as theorem provers- Agent Oriented Programming - Concurrent Metate M- Practical Reasoning Agents

UNIT-II TYPES OF AGENTS 9

Reactive and Hybrid Agents - Brook_s and Subsumption Architecture –The Limitations of Reactive Agents - Hybrid Agents. Communication - Speech Acts - Agent Communication Languages, Working Together - Cooperative Distributed Problem Solving - Task Sharing and Result Sharing Coordination – Multi agent Planning and Synchronization

UNIT-III MULTI-AGENT INTERACTIONS 9

Making group decisions- Co-operative games - Allocating scarce resources

UNIT-IV BARGAINING 9

Bargaining for resource division, task allocation and resource allocation - Arguing – Abstract, deductive, dialogue and implemented argumentation systems –Applications – Agents for different domains

UNIT-V JADE 9

Agent Oriented Language - The JADE Platform – Programming with JADE – Basic Features

REFERENCES:

1. Michael Wooldridge, ―An Introduction to MultiAgent Systems‖, II edition, John Wiley & Sons, Ltd. 2009.
2. Fabio Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi agent Systems with JADE, John Wiley and Sons Ltd, 2007.
3. Gerhard Weiss, ―Multi Agent Systems: A Modern Approach to Distributed Artificial Intelligence‖, The MIT press, 2000.

COURSE OUTCOMES (COs)	
CO1	Understand the notions of the intelligent agent and multi
CO2	Describe Reactive and Hybrid Agents
CO3	Identify the basic application areas of intelligent agents
CO4	Apply bargaining and augmentative techniques.
CO5	Explore the basics of the agent oriented languages.
CO6	Design multi agent systems for real time problems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**

CO1			1	2		1			2		1	3	3	1	1
CO2	2	3	1	2		1			2	1		3	3	1	1
CO3	2	3	1	2		1			2	1		3	3	1	1
CO4	2		1	2		1			2	1		3	3	1	1
CO5	2		1	2		1			2		1	3	3	1	1
CO6	2		1	2		1			2	1	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT043	**MINING SOCIAL MEDIA**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Data Mining				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To use different tools for collecting, analyzing, and exploring social media data for research and development purposes.
- To process the collected data, primarily structured using methods involving correlation, regression, and classification to derive insights about the sources and people who generated that data.
- To apply best practices in Search Engine

UNIT - I INTRODUCTION 9

What is Social Media Mining - New Challenges fir Mining - Essentials - Graph Essentials- Graph Basics -Graph Representation p- Types of Graph - Connctivity in Graphs - Special Graphs - Graph Algorithms.

UNIT - II NETWORK MEASURES 9

Network Measures - Entity - Transitivity and Reciprocity - Balance and Status - Network Models - Properties of Real-World Networks - Random Graphs - Small-World Models - Preferential Attached Models - Data Mining Essentials - Data Pre-processing - Data mining Algorithms - Supervised Learning - Unsupervised Learning.

UNIT - III COMMUNITY AND INTERACTIONS 9

Community Analysis - Community Detection - Community Evolution - Community Evaluation - Information Diffusion in Social Media - Herd Behavior - Information Cascades - Diffusion of innovations - Epidemics.

UNIT - IV APPLICATIONS 9

Inference and Homophily - Measuring Assortativity - Influence - Homophily- Distinguishing Influence and Homophily - Recommendation in Social Media -Challenges - Classical Recommendation Algorithms - Recommendation Using Social Context - Evaluating Recommendation- Behavior Analytics Individual Behavior - collective Behavior.

UNIT -V CASE STUDY 9

Gathering social media data - Building social media networks - Analyzing network effects- Simulating network dispersion

TEXT BOOK

1. Social Media Mining: An Introduction, Reza Zafarinin, Mohammad Ali Abbasi, Huan Lui - April 2014.

REFERENCES:

1. Mining Text Data , Charu C. Aggarwal, ChengXiang Zhai, Springer 2012.
2. Mastering Social Media Mining with Python, Macro Bonzanini, Packt publications July 2016.

COURSE OUTCOMES (COs)	
CO1	Utilize various Application Programming Interface (API) services to collect data from different social media sources such as YouTube, Twitter, and Flickr.
CO2	Process the collected data, primarily structured using methods involving correlation, regression, and classification to derive insights about the sources and people who generated that data.
CO3	Perform social network analysis to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites such as Twitter, Facebook, and YouTube.
CO4	Apply best practices in Search Engine.
CO5	Design ethical principles to the use of web and social media data.
CO6	Build social networks

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2					2	3		1		3		
CO2	3		2			1		2	3		1	1	3		
CO3	3		2		1			2	3	2	1	2	3		
CO4	3		2	1				2	3	2	1	2	3		
CO5	3		2			1		2	3		1	3	3		
CO6	3		2	1	1	1		2	3	2	1	3			
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT044	**DIGITAL AND MEDICAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Image processing				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- The aim of the course is to show how to extract, model, and analyze information from medical data and application in order to help diagnosis , treatment and monitoring of diseases through computer science.

UNIT-I DIGITAL IMAGE FUNDAMENTAL 9

Elements of digital image processing systems, Elements of Visual perception, Image formation model, Image sampling and quantization, aliasing, zooming and shrinking of digital images. Monochrome Vision Model, Colour Vision Model. Image transforms –Discrete Fourier transform, Properties of Fourier transform, Fast Fourier transform and inverse fast Fourier transform.

UNIT-II IMAGE FUNDAMENTALS 9

Image sampling and quantization, Matrix and Singular Value representation of discrete images. Image pre-processing, point operation, Histogram 119odeling, spatial operations, transform operations.

UNIT-III IMAGE ENHANCEMENT 9

Enhancement by point processing –Simple intensity transformation –Histogram processing – Image subtraction –Image averaging. Spatial filtering –Smoothing filters, sharpening filters. Enhancements in frequency domain-Low pass filtering –High pass filtering.

UNIT-IV IMAGE ANALYSIS, CLASSIFICATION AND RECONSTRUCTION OF ACT AND MRI IMAGES 9

Image analysis, Spatial feature extraction, edge detection, Image segmentation. Image reconstruction from projections, Random transform, filter back projection algorithm, reconstruction of CT images, Imaging methods in MF images, fourier reconstruction of MRI.

UNIT-V TRANSMISSION OF MEDICAL IMAGES 9

Medical Image, data compression of transmission, transform coding, pixelCoding, predictive coding, Interference coding.

TEXT BOOKS:

1. Kavyan Najarian and Robert Splerstor ‖Biomedical Signals and Image Processing‖, CRC – Taylor and Francisn, New York, 1991.
2. John L. Semmlow, ‒Biosignal and Biomedical Image Processing Matlab Based applications‖ Marcel Dekker Inc., New York, 2004.

COURSE OUTCOMES (Cos)	
CO1	Acquire a fundamental knowledge of digital image processing with Fourier transforms.
CO2	Learn about the image sampling, Modeling and quantization techniques.
CO3	Explain the image enhancement, its process and types of filters used in image processing.
CO4	Apply image analysis, classification and reconstruction techniques in images.
CO5	Acquire the skills in the transmission of medical images.
CO6	Design real time applications for processing medical images.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	3		
CO2	2	3	1	2		1			2	1		3	3		

CO3	2	3	1	2		1			2	1		3	3		
CO4	2		1	2		1			2	1		3	3		
CO5	2		1	2		1			2		1	3	3		
CO6	2	3	1	2		1			2	1	1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT045	**MULTIMEDIA COMPRESSION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

The student should be made to:

- Understand error–control coding.
- Understand encoding and decoding of digital data streams.
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- Be aware of compression and decompression techniques.
- Learn the concepts of multimedia communication.

UNIT I MULTIMEDIA COMPONENTS

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

UNIT II AUDIO AND VIDEO COMPRESSION

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.

UNIT III TEXT AND IMAGE COMPRESSION

Compression principles-source encoders and destination encoders-lossless and lossy compression- entropy encoding –source encoding -text compression – static Huffman coding dynamic coding – arithmetic coding –Lempel Ziv-Welsh Compression-image compression.

UNIT IV VOIP TECHNOLOGY

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability.

UNIT V MULTIMEDIA NETWORKING

Multimedia networking -Applications-streamed stored and audio-making the best Effort service- protocols for real time interactive Applications-distributing multimedia-beyond best effort service- secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

TEXT BOOKS:

1. Fred Halshall –Multimedia Communication - Applications, Networks, Protocols and Standards‖, Pearson Education, 2007.
2. Tay Vaughan, –Multideai: Making it Work‖, 7 th Edition, TMH 2008 98.

3. Kurose and W.Ross‖ Computer Networking –a Top down Approach, Pearson Education 2005.

REFERENCES:

1. Marcus Goncalves –Voice over IP Networks‖, Mc Graw Hill 1999.
2. KR. Rao,Z S Bojkovic, D A Milovanovic, –Multimedia Communication Systems: Techniques, Standards, and Networks‖, Pearson Education 2007.
3. R. Steimnetz, K. Nahrstedt, –Multimedia Computing, Communications and Applications‖, Pearson Education Ranjan Parekh, –Principles of Multimedia‖, TMH 2007.

COURSE OUTCOMES (COs)	
CO1	Explore the basic components of multimedia.
CO2	Analyze audio and video compression techniques.
CO3	Apply text and image compression techniques.
CO4	Evaluate the basic concepts of Voice Over Internet Protocol.
CO5	Understand the concepts of multimedia networking and its applications.
CO6	Design interactive real time multimedia applications.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	2		
CO2	2	3	1	2		1			2	1		3	2		
CO3	2	3	1	2		1			2	1		3	2		
CO4	2		1	2		1			2	1		3	2		
CO5	2		1	2		1			2		1	3	2		
CO6	2	3	1	2		1			2	1	1	3	2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT046	**AGILE METHODOLIGY**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To provide students with a theoretical as well as practical understanding of agile software
- To develop practices and how small teams can apply them to create high-quality software.

UNIT I AGILE METHODOLOGY 9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design- Testing – Agile Documentations – Agile Drivers- Capabilities and Values

UNIT II AGILE PROCESSES 9

Lean Production – SCRUM, Crystal, Feature Driven Development- Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products- Roles and Practices.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT 9

Agile Information Systems – Agile Decision Making – Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING 9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of REUsing Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment- Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILITY AND QUALITY ASSURANCE 9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development.

TEXT BOOKS:

1. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

REFERENCES:

1. Craig Larman, ―Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
2. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

COURSE OUTCOMES (COs)	
CO1	Understand the fundamentals of agile methodology.
CO2	Explore the various agile processes for software development.
CO3	Demonstrate knowledge management in Agile methodology.
CO4	Describe the benefits and pitfalls of working in an Agile team and to understand Agile development, deployment and testing.
CO5	Apply agile approach to quality assurance.
CO6	Design applications using Agile approach in Global Software Development

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2					2	3		1				2
CO2	3		2			1		2	3		1	1			2
CO3	3		2		1			2	3	2	1	2			2
CO4	3		2	1				2	3	2	1	2			2
CO5	3		2			1		2	3		1	3			2
CO6	3		2	1	1	1		2	3	2	1	3			2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT051	**INTERNET OF THINGS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Computer Architecture				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TEXTBOOK:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

COURSE OUTCOMES (COs)	
CO1	Explain the concept of IoT.
CO2	Analyze various protocols for IoT.
CO3	Design a PoC of an IoT system using Rasperry Pi/Arduino
CO4	Apply data analytics and use cloud offerings related to IoT.
CO5	Analyze applications of IoT in real time scenario
CO6	Implement Industrial IoT applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	3	1	1
CO2	2	3	1	2		1			2	1		3	3	1	1
CO3	2	3	1	2		1			2	1		3	3	1	1
CO4	2		1	2		1			2	1		3	3	1	1
CO5	2		1	2		1			2		1	3	3	1	1
CO6	2	3	1	2		1			2	1	1	3	3		

Category	Professional Electives(PE)
Approval	49th meeting of the Academic Council

	ARTIFICIAL INTELLIGENT GAME	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3

U18PEIT052	Prerequisite – Principles of Artificial Intelligence
	Course Designed by:- Dept of Information Technology

OBJECTIVES

- Study The Concepts Of Artificial Intelligence.
- Learn The Methods Of Solving Problems Using Artificial Intelligence.
- Introduce The Concepts Of Expert Systems And Machine Learning.

UNIT I INTRODUCTION 9

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II PROBLEM SOLVING METHODS 9

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games

UNIT III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information

UNIT IV SOFTWARE AGENTS 9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems

UNIT V APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

TEXT BOOK

1. S. Russell and P. Norvig, –Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. M. Tim Jones, ―Artificial Intelligence: A Systems Approach (Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
4. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
5. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

COURSE OUTCOMES (COs)	
CO1	Identify problems that are amenable to solution by Artificial Intelligence methods.

CO2	Select appropriate Artificial Intelligence methods to solve a given problem.
CO3	Formalize a given problem in the language/framework of different Artificial Intelligence methods.
CO4	Represent knowledge, design intelligent agents and apply the suitable Artificial Intelligence algorithms for problem solving and reasoning.
CO5	Design and carry out an empirical evaluation of different Artificial Intelligence algorithms
CO6	Learn the concepts of problem solving, reasoning, planning, natural language understanding, computer vision and machine learning and design real time Artificial Intelligence applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1			1	2		1			2		1	3	3		2
CO2	2	3	1	2		1			2	1		3	3		2
CO3	2	3	1	2		1			2	1		3	3		2
CO4	2		1	2		1			2	1		3	3		2
CO5	2		1	2		1			2		1	3	3		2
CO6	2	3	1	2		1			2	1	1	3	3		2

Category	Professional Electives(PE)
Approval	49th meeting of the Academic Council

U18PEIT053	**INFERENTIAL STATISTICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Data mining				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES
To enable students to analyze and interpret data, collected data from a variety of types of research designs, within a linear model framework.

UNIT 1 INTERVAL ESTIMATION 10

Concepts of confidence interval and confidence coefficient - confidence interval for mean - difference between means - variance and ratio of variances under normality. Large sample confidence interval for proportions and correlation coefficients

UNIT II TESTING OF HYPOTHESIS 9

Definition of Most Powerful (MP) - Uniformly Most Powerful(UMP) - Neyman Pearson Lemma - Monotone Likelihood Ratio Property - Statement of the theorem -UMP tests for testing one sided hypothesis for distribution with MLR property.

UNIT III LIKELIHOOD RATIO TEST 9

Likelihood Ratio test- LRT for single mean for normal case (large and small samples)- for equality of two means for unknown but equal variances. LRT for single variance and equality

of two variances

UNIT IV NON PARAMETRIC TESTS 9

Need for non parametric tests- Sign test for one sample and two samples- Wilcoxon signed rank test- Median test- Wald Wolfowitz run test- Mann Whitney U test- Run test for randomness- test for independence based on Spearman's rank correlation coefficient(small and large samples)- Chi square test- goodness of fit- independence of attributes in contingency table - and equality of many proportions. Kruskal Wallis Test for equality of several means.

UNIT V SEQUENTIAL PROBABILITY RATIO TEST 8

Need for sequential test- Wald's SPRT- Sequential test for the mean of Normal population when variance is known and for the proportion- Derivation of expressions for OC and ASN functions in Bernoulli and Normal distributions.

TEXT BOOK

1. Inferential Statistics, S. Roychowdhury D. Bhattacharya, U.N.DHUR & Sons Private Ltd, 2012

REFERENCES

1. Probability and Statistical Inference Theory & Practices, S. Roychowdhury D. Bhattacharya, U.N.DHUR & Sons Private Ltd . 2015
2. Statistics and Data Analysis, A. Abebe, J.Daniel, J.W. McKean,

COURSE OUTCOMES (COs)	
CO1	Understand the analysis of Variance (ANOVA) or Analysis of Covariance (ANCOVA)
CO2	Analyze and interpret data collected from factorial designs.
CO3	Use the multiple linear regression (MLR) procedures to compute partial and semi-partial correlation analyses and interpret the results
CO4	Infer data from a prediction study using one criterion variable and multiple predictor variables.
CO5	Interpret ANOVA, ANCOVA, and MLR results reported in published reports of research.
CO6	Evaluate the reliability and validity of a measuring (or survey) instrument.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2	2						3		1			2	2
CO2	3	2	2			1			3		1	1		2	2
CO3	3	2	2		1				3	2	1	2		2	2
CO4	3	2	2	1					3	2	1	2		2	2
CO5	3	2	2			1			3		1	3		2	2
CO6	3	2	2			1			3		1	3		2	2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT054	DEEP LEARNING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Principles of Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

This course covers the basics of machine learning, neural networks and deep learning. Model for deep learning technique and the various optimization and generalization mechanisms are included. Major topics in deep learning and dimensionality reduction techniques are covered.

UNIT I INTRODUCTION **9**

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DEEP NETWORKS **9**

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT III DIMENTIONALITY REDUCTION **9**

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT IV OPTIMIZATION AND GENERALIZATION **9**

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions

REFERENCES:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES (COs)

CO1	Explain the mathematical, statistical and computational challenges of building neural networks
CO2	Understand the concepts of Machine Learning
CO3	Explore the concepts of deep learning
CO4	Apply dimensionality reduction techniques in deep learning applications
CO5	Describe the optimization and generalization for deep networks
CO6	Design real time applications using deep learning techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	3		2
CO2	2	3	1	2		1			2	1		3	3		2
CO3	2	3	1	2		1			2	1		3	3		2
CO4	2		1	2		1			2	1		3	3		2
CO5	2		1	2		1			2		1	3	3		2
CO6	2		1	2		1			2		1	3	3		2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT055	**SOFTWARE QUALITY**	**L**	**T**	**P**	**C**
	Total Contact Periods - 45	3	0	0	3
	Prerequisite – Software Engineering Methodologies				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To develop a broad understanding of SQA processes from planning until execution
- To have detailed knowledge of techniques in an appropriate engineering and management context.

UNIT I **9**

Introduction to software quality – Software modeling – Scope of the software quality program – Establishing quality goals – Purpose, quality of goals – SQA planning software – Productivity and documentation.

UNIT II **9**

Software quality assurance plan – Purpose and Scope, Software quality assurance Management – Organization – Quality tasks – Responsibilities – Documentation.

UNIT III **9**

Standards, Practices, Conventions and Metrics, Reviews and Audits – Management - Technical review – Software inspection process – Walk through process – Audit process – Test processes – ISO, cmm compatibility – Problem reporting and corrective action.

UNIT IV **9**

Tools, Techniques and methodologies, Code control, Media control - Supplier control -

Records collection - Maintenance and retention - Training and risk management.

UNIT V **9**

ISO 9000 model - CMM model- Comparisons- ISO 9000 weaknesses- CMM weaknesses- SPICE – Software process improvement and capability determination.

TEXT BOOK

1. Mordechai Ben – Meachem and Garry S.Marliss, ―Software Quality – Producing Practical, Consistent Software‖, International Thompson Computer Press, 1997.

REFERENCES

1. Watt. S. Humphrey, ―Managing Software Process‖, Addison – Wesley, 1998.
2. Philip.B.Crosby, ―Quality is Free: The Art of making quality certain‖, Mass Market, 1992.

COURSE OUTCOMES (COs)	
CO1	Understand the quality management processes
CO2	Describe the various activities of quality assurance, quality planning and quality control
CO3	Define the importance of standards in the quality
CO4	Discuss the needs for software process assessment and improvement
CO5	Explore the different software quality factors models
CO6	Apply tools, techniques and methodologies to ensure software quality

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1			1	2		1			2		1	3	3	3	3
CO2	2	3	1	2		1			2	1		3	3	3	3
CO3	2	3	1	2		1			2	1		3	3	3	3
CO4	2		1	2		1			2	1		3	3	3	3
CO5	2		1	2		1			2		1	3	3	3	3
CO6	2		1	2		1			2		1	3	3	3	3
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT056	**SOFTWARE ARCHITECTURE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- To develop Computer Science, Software Engineering or Computer Engineering student
- To understand the emerging field of software architecture means to the field of software development.

UNIT I **9**

Introduction – Software Architecture – Engineering Discipline for Software – Status of Software Architecture Architectural Styles – Pipes and Filters – Data Abstraction and Object Oriented Organization – Event Based Implicit Invocation – Layered Systems – Repositories – Interpreters – Process Control – Other Architectures – Hetero Generous Architecture – Case Studies.

UNIT II **9**

Shared Information Systems – Database Integration – Integration in Software Development Environments – Integration in the Design of Build – Architectural Structures for Shared Information Systems – Conclusions.

UNIT III **9**

Architectural Design Guidance – Guidance for User-Interface Architectures – The Quantified Design Phase.

UNIT IV **9**

Formal Model and Specification – The Value of Architectural Formalism – Formalizing the Architecture of a Specific System – Formalizing an Architectural Style – Formalizing and Architectural Design Space – Theory of Software Architecture – Notation Linguistic Issues – Requirement for Architecture – Description Languages – First Class Connectors – Adding Implicit Invocation to Traditional Programming Languages.

UNIT V **9**

Tools for Architectural Design – Unicon – Exploiting Style in Architectural Design Environments – Beyond Definition / Use.

TEXT BOOK

1. Mary Shaw and David Garlan , ―Software Architecture : Perspectives on an Emerging Discipline‖ ,Prentice – Hall of India, New Delhi, 2000.

REFERENCE

1. Bass, Lan, Clements, Paul and Kazman, Rick, ―Software Architecture in Practice, Addison Wesley, 1998.

COURSE OUTCOMES (Cos)	
CO1	Understand the Software Architectural perspective and how it differs from lower-level design.
CO2	Describe the integration in Software Development process.
CO3	Apply the architectural structures for shared information systems.
CO4	Develop architectural approaches from basic requirements.
CO5	Define the architectural frameworks within product line development.
CO6	Apply tools for software architectural designs.

Mapping of Course Outcomes with Program outcomes (Pos) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3		2						3		1		3		
CO2	3		2			1			3		1	1	3		
CO3	3		2		1				3	2	1	2	3		
CO4	3		2	1					3	2	1	2	3		
CO5	3		2			1			3		1	3	3		
CO6	3		2			1			3		1	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT061	**QUANTUM COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by:- Dept of Information Technology				
OBJECTIVES	Students will be well versed in Quantum computation and algorithms, Basic quantum mechanics, quantum cryptographic protocols, quantum teleportation, polynomial-time factoring, quantum error correction, and a new graphical calculus for reasoning about quantum systems				

UNIT I FOUNDATION 9

Overview of traditional computing – Church-Turing thesis – circuit model of computation – reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem.

UNIT II QUBITS AND QUANTUM MODEL OF COMPUTATION 9

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits.

UNIT III QUANTUM ALGORITHMS – I 9

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch-Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform.

UNIT IV QUANTUM ALGORITHMS – II 9

Order-finding problem – eigen value estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.

UNIT V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

Computational complexity – black-box model – lower bounds for searching – general black-

box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.

TEXTBOOK:

1. P. Kaye, R. Laflamme, and M. Mosca, –An introduction to Quantum Computing|, Oxford University Press, 1999.

REFERENCE:

1. V. Sahni, –Quantum Computing|, Tata McGraw-Hill Publishing Company, 2007.

COURSE OUTCOMES (COs)	
CO1	Translate fluently between the major mathematical representations.
CO2	Implement basic quantum algorithms.
CO3	Understand quantum decoherence in systems for computation.
CO4	Apply eigenvalue estimation approach to order finding.
CO5	Describe the quantum error correction techniques.
CO6	Designing fault tolerant quantum computing systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3		2		3			1				2		
CO2					3		2	3	2	3		2	2		
CO3	1	1		1		2					3		2		
CO4	3	3		2	2	3	2	2	2			1	2		
CO5	3			2	2	2	2	1		2	2		2		
CO6	3			2	2	2	2	1		2	2		2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT062	**REAL TIME SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Database Management System				
	Course Designed by:- Dept of Information Technology				
OBJECTIVES	The main objective of this course is to cover the principles and design methods of real-time computer systems. It covers the interfacing techniques and microprocessor system realization. The principles of real-time operating systems and real-time software system				

UNIT I INTRODUCTION 9

Issues in Real Time Computing, Structure of a Real Time System. Task Classes, Performance Measures for Real Time Systems, Estimating Program Run times. Task Assignment and Scheduling –Classical Uniprocessor scheduling algorithms, UniProcessor. Scheduling of IRIS Tasks, Task Assignment,Mode Changes, and Fault Tolerant Scheduling.

UNIT II PROGRAMMING LANGUAGES AND TOOLS 9

Programming Language and Tools – Desired Language characteristics, Data Typing, Control structures, Facilitating Hierarchical Decomposition, Packages, Runtime (Exception) Error handling, Overloading andGenerics, Multitasking, Low Level programming, Task scheduling, Timing Specifications, Programming Environments, Run-time Support.

UNIT III REAL TIME DATABASES 9

Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases,134ransact ion priorities, Transaction Aborts, Concurrency Control Issues, Disk Scheduling Algorithms,

Twophase Approach to improve Predictability, Maintaining Serialization Consistency, Data bases for Hard Real Time systems.

UNIT IV COMMUNICATION 9

Real-Time Communication – Communications Media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types, Fault Detection. Fault Error containment Redundancy, Data Diversity, Reversal Checks, Integrated Failure handling.

UNIT V EVALUATION TECHNIQUES 9

Reliability Evaluation Techniques – Obtaining Parameter Values, Reliability Models for Hardware Redundancy, Software Error models. Clock Synchronization – Clock, A Nonfault-Tolerant Synchronization Algorithm, Impact of Faults, Fault Tolerant Synchronization in Hardware, Fault Tolerant Synchronization in Software

TEXT BOOK:

1. C.M. Krishna, Kang G. Shin, ―Real-Time Systems‖, McGraw-Hill International Editions, 1997.

REFERENCES:

1. Stuart Bennett, –Real Time Computer Control-An Introduction‖,Second edition Prentice Hall PTR, 1994.
2. Peter D. Lawrence, –Real time Micro Computer System Design – An Introduction‖,McGr aw Hill, 1988.
3. S.T. Allworth and R.N. Zobel, –Introduction to real time software design‖, Macmillan, II Edition, 1987.
4. R.J.A Buhur, D.L. Bailey, ― An Introduction to Real-Time Systems‖, Prentice-Hall International, 1999.
5. Philip.A.Laplante –Real Time System Design and Analysis‖ PHI , III Edition, April 2004.

COURSE OUTCOMES (Cos)	
CO1	Understand the basics concepts of real-time systems.
CO2	Generate a high-level analysis document based on requirements specifications.
CO3	Describe the basic multi-task scheduling algorithms for periodic, aperiodic.
CO4	Apply fault tolerant routing for the real time communication and communications media.
CO5	Implement reliability evaluation techniques to identify software error models.
CO6	Design real time systems by interacting with the environment.
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

Cos\ Pos	1	2	3	4	5	6	7	8	9	10	11	12	PS 01	PS 02	PS 03
CO1	3	3		2		1						3	2		
CO2	3	3			3		1	3	2	3			2		
CO3	3	3	1			2					3		2		
CO4	3	3		2	2	3	1	2	2			2	2		
CO5	3	3		2	2	2	2			2	2		2		
CO6	3	3		2	2	2	2			2	2		2		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT063	COMPUTER GRAPHICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Architecture				
	Course Designed by:- Dept of Information Technology				

OBJECTIVES

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.

UNIT I INTRODUCTION 9

Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software; Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

UNITII TWO DIMENSIONAL GRAPHICS 9

Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

UNIT III THREE DIMENSIONAL GRAPHICS 9

Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations – Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces –B-Spline curves and surfaces.

TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

UNIT IV ILLUMINATION AND COLOUR MODELS 9

Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive colour concepts –

RGB colour model – YIQ colour model – CMY colour model – HSV colour model – HLS colour model; Colour selection.

UNIT V ANIMATIONS & REALISM ANIMATION GRAPHICS 9

Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing – tweening. COMPUTER GRAPHICS REALISM: Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing.

TEXT BOOKS:

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,‖Computer Graphics: Principles and Practice‖, , 3rd Edition, Addison- Wesley Professional,2013. (UNIT I, II, III, IV).
2. Donald Hearn and Pauline Baker M, ―Computer Graphics‖, Prentice Hall, New Delhi, 2007 (UNIT V).

REFERENCES:

1. Donald Hearn and M. Pauline Baker, Warren Carithers,―Computer Graphics With Open GL‖, 4th Edition, Pearson Education, 2010.
2. Jeffrey McConnell, ―Computer Graphics: Theory into Practice‖, Jones and Bartlett Publishers, 2006.
3. Hill F S Jr., ―Computer Graphics‖, Maxwell Macmillan‖ , 1990.
4. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, Fundamental of Computer Graphics, CRC Press, 2010.
5. William M. Newman and Robert F.Sproull, ―Principles of Interactive Computer Graphics‖, Mc GrawHill 1978.

COURSE OUTCOMES (Cos)	
CO1	Equip with the practical skills necessary to build computer vision applications.
CO2	Describe the object, scene recognition and categorization from images.
CO3	Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
CO4	Explore the different illumination and color models.
CO5	Implement motion related techniques.
CO6	Develop applications using computer vision techniques.

Mapping of Course Outcomes with Program outcomes (Pos)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3		2								2	3		
CO2					3		2		2	3			3		
CO3						2					3	2	3		
CO4	3	2		2	2	3	2		2				3		

CO5	3			2	2	2	2			2	2	3	3		
CO6	3			2	2	2	2			2	2	3	3		
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT064	**BUSINESS INTELLIGENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Database Management System				
	Course Designed by:- Dept of Information Technology				

OBJECTIVE

The objective of this course is to explore business intelligence and data mining, using powerful yet user friendly tools, with exposure to real world business applications.

UNIT I BUSINESS INTELLIGENCE 9

Effective And Timely Decisions – Data, Information And Knowledge – Role Of Mathematical Models – Business Intelligence Architectures: Cycle of A Business Intelligence Analysis – Enabling Factors In Business Intelligence Projects – Development of a Business Intelligence System – Ethics And Business Intelligence.

UNIT II KNOWLEDGE DELIVERY 9

The Business Intelligence User Types, Standard Reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports And Self-Service Reporting, Dimensional Analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards And Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing The Presentation For The Right Message.

UNIT III EFFICIENCY 9

Efficiency Measures – The CCR Model: Definition Of Target Objectives- Peer Groups – Identification Of Good Operating Practices; Cross Efficiency Analysis – Virtual Inputs And Outputs – Other Models. Pattern Matching – Cluster Analysis, Outlier Analysis.

UNIT IV BUSINESS INTELLIGENCE APPLICATIONS 9

Marketing Models – Logistic And Production Models – Case Studies.

UNIT V FUTURE OF BUSINESS INTELLIGENCE 9

Future of Business Intelligence – Emerging Technologies, Machine Learning, Predicting The Future, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future Beyond Technology.

TEXT BOOK:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, –Decision Support And Business Intelligence Systems‖, 9th Edition, Pearson 2013.

REFERENCES:

1. Larissa T. Moss, S. Atre, –Business Intelligence Roadmap: The Complete Project Lifecycle Of Decision Making‖, Addison Wesley, 2003.
2. Carlo Vercellis, ―Business Intelligence: Data Mining And Optimization For Decision Making‖, Wiley Publications, 2009.
3. David Loshin Morgan, Kaufman, –Business Intelligence: The Savvy Manager‟S Guide‖,

Second Edition, 2012.
4 Cindi Howson, –Successful Business Intelligence: Secrets To Making BI A Killer App‖, McGraw-Hill, 2007.
5. Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, –The Data Warehouse Lifecycle Toolkit‖, Wiley Publication Inc.,2007.

COURSE OUTCOMES (COs)	
CO1	Understand the basics Business Intelligence.
CO2	Learn Standard Reports, Interactive Analysis and Ad Hoc Querying.
CO3	Understand Efficiency Measures and CCR Model.
CO4	Understand business Intelligence applications.
CO5	Design Business Intelligence Applications for real time cases.
CO6	Predict the future of Business Intelligence and explore the emerging technologies

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3		2	3	3						1	2		2
CO2							2	3	2	3			2		2
CO3						2					3	2	2		2
CO4	3	2		2	2		2	2	2				2		2
CO5	3			2	2	2	2			2	2	3	2		2
CO6	3	2		2	2	2	2			2	2	3	2		2
Category	Professional Electives(PE)														
Approval	49th meeting of the Academic Council														

U18PEIT065	**INFORMATION THEORY AND CODING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Multimedia Systems				
	Course Designed by:- Dept of Information Technology				
OBJECTIVES	• Understand Error–Control Coding.				
	• Understand encoding and decoding of digital data streams. • Be Familiar with the methods for the generation of these codes and their decoding techniques. • Be aware of compression and decompression techniques. • Learn the Concepts of Multimedia Communication.				

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9

Uncertainty, Information And Entropy – Source Coding Theorem – Huffman Coding – Shannon Fano Coding – Discrete Memory Less Channels – Channel Capacity – Channel Coding Theorem – Channel Capacity Theorem.

UNIT II DATA AND VOICE CODING 9

Differential Pulse Code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive

Subband Coding – Delta Modulation – Adaptive Delta Modulation – Coding Of Speech Signal At Low Bit Rates (Vocoders, LPC).

UNIT III ERROR CONTROL CODING 9

Linear Block Codes – Syndrome Decoding – Minimum Distance Consideration – Cyclic Codes – Generator Polynomial – Parity Check Polynomial – Encoder For Cyclic Codes – Calculation Of Syndrome – Convolutional Codes.

UNIT IV COMPRESSION TECHNIQUES 9

Principles – Text Compression – Static Huffman Coding – Dynamic Huffman Coding – Arithmetic Coding – Image Compression – Graphics Interchange Format – Tagged Image File Format – Digitized Documents – Introduction to JPEG Standards.

UNIT V AUDIO AND VIDEO CODING 9

Linear Predictive Coding – Code Excited LPC – Perceptual Coding, MPEG Audio Coders – Dolby Audio Coders – Video Compression – Principles – Introduction To H.261 & MPEG Video Standards.

TEXT BOOKS:

1. Simon Haykin, ―Communication Systems‖, 4th Edition, John Wiley And Sons, 2001.
2. Fred Halsall, ―Multimedia Communications, Applications Networks Protocols And Standards‖, Pearson Education, Asia 2002; Chapters: 3,4,5.

REFERENCES:

1. Mark Nelson, ―Data Compression Book‖, BPB Publication 1992.
2. Watkinson J, ―Compression In Video And Audio‖, Focal Press, London, 1995.

COURSE OUTCOMES (COs)	
CO1	Understand the fundamentals of Information Entropy and channel capacity for various channels
CO2	Compare various data and voice source coding techniques
CO3	Inspect error detection and describe the different error control coding techniques
CO4	Apply the different compression techniques for real time applications.
CO5	Describe the concepts of Audio and video coding techniques.
CO6	Implement the different coding techniques to design applications in multimedia communication systems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

COs\ POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	2	1	1								2	2	2	
CO2	3	1	1	1							2		2	2	
CO3	3	2	2	2									2	2	
CO4	3	2	2	2					2		2	2	2	2	
CO5	3	2	2	2					2			2	2	2	
CO6	3	2	2	2					2			2			
Category	Professional Electives(PE)														

Approval	49th meeting of the Academic Council

U18PEIT066	**MULTI AGENT INTELLIGENT SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Artificial Intelligence				
	Course Designed by:- Dept of Information Technology				
OBJECTIVES	The purpose of this course is to impart concepts of Artificial Intelligence and different agents.				

UNIT I INTRODUCTION 9

Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics -Constraint Satisfaction Problems - Game playing.

UNIT II KNOWLEDGE REPRESENTATION AND REASONING 9

Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies Knowledge Representation-Objects-Actions-Events.

UNIT III PLANNING AGENTS 9

Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains Conditional Planning-Continuous Planning-Multi Agent Planning.

UNIT IV AGENTS AND UNCERTAINITY 9

Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.

UNIT V HIGHER LEVEL AGENTS 9

Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning Communication-Formal Grammar-Augmented Grammars- Future of AI.

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, –Artificial Intelligence - A Modern Approach‖, 2nd Edition, Prentice Hall, 2002.
2. Michael Wooldridge, –An Introduction to Multi Agent System‖, John Wiley, 2002.

REFERENCE BOOKS:

1. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.
2. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

COURSE OUTCOMES (COs)	
CO1	Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions.
CO2	Demonstrate awareness of informed search and exploration Methods.
CO3	Explain about AI techniques for knowledge representation and planning.
CO4	Apply probabilistic/statistical approaches to act in uncertain environment.
CO5	Understand the different learning approaches and make the machine to perform human-like tasks.
CO6	Prepare for future by integrating Artificial Intelligence in real time.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

Cos\ Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PS 01**	**PS 02**	**PS 03**
CO1	3	3	2	2					3	2		2	3		
CO2	2	3	2	2					2	2		2	3		
CO3	2	3	2	2				2	2	2			3		
CO4	3	3	2	2					2	2		2	3		
CO5	2	3	2	2				2	2	2	2	2	3	2	
CO6	3	3	2	2					2	2	2	2	3	2	

Category	Core Elective(CE)
Approval	49th meeting of the Academic Council

CURRICULUM AND SYLLABUS(R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
B.Tech – COMPUTER SCIENCE & ENGINEERING
(FULL TIME)

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematic- I	4	4	0	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
8	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
9	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
111	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
Total				31	14	0	17	22.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics- II	4	4	0	0	4
3	U18BSPH202	BS	Semi Conductor Physics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAB203	MC	Yoga	2	0	0	2	0
11	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	34	16	1	12	23.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA303	BS	Probability and Statistics	4	3	1	0	4
2	U18PCCS301	PC	Data Structures & Algorithm	3	3	0	0	3
3	U18PCCS302	PC	Object Oriented Programming	3	3	0	0	3
4	U18PCCS303	PC	Computer Organization & Architecture	3	3	0	0	3
5	U18ESEC303	ES	Digital Electronics	3	3	0	0	3
PRACTICAL								
6	U18PCCS3L1	PC	Data Structures and Algorithm Laboratory	3	0	0	3	1.5
7	U18PCCS3L2	PC	Object Oriented Programming Lab	3	0	0	3	1.5
8	U18ESEC3L3	ES	Digital Electronics Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	29	15	1	13	20.5

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA403	BS	Discrete Mathematics	4	3	1	0	4
2	U18PCCS401	PC	Cloud Computing	3	3	0	0	3
3	U18PCCS402	PC	Design and Analysis of Algorithm	3	3	0	0	3
4	U18PCCS403	PC	Data Base Management System	3	3	0	0	3
5	U18PCCS404	PC	Operating Systems	3	3	0	0	3
6	U18PCCS405	PC	Formal Language and Automata Theory	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
7	U18PCCS4L1	PC	Operating System Laboratory	3	0	0	3	1.5
8	U18PCCS4L2	PC	Design and Analysis of Algorithm Laboratory	3	0	0	3	1.5
9	U18PCCS4L3	PC	DBMS Lab	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAC407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
11	U18MCAC408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	32	18	1	13	23.5

SEMESTER V								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCCS501	PC	Artificial Intelligence	3	3	0	0	3
2	U18PCCS502	PC	Software Engineering	3	3	0	0	3
3	U18PCCS503	PC	Functional Programming	3	3	0	0	3
4	U18PCCS504	PC	Computer Networks	3	3	0	0	3
5	U18HSBA501	HS	Organizational Behaviour	3	3	0	0	3
6	U18BSCH501	MC	Constitution of India	2	2	0	0	0
7	U18PECS5E1	PE	Programme Elective-I	3	3	0	0	3
PRACTICAL								
8	U18PCCS5L1	PC	Software Engineering Laboratory	3	0	0	3	1.5
9	U18PCCS5L2	PC	Network Programming Laboratory	3	0	0	3	1.5
10	U18PCCS5L3	PC	Functional Programming Laboratory	3	0	0	3	1.5
11	U18EECS5S1	PR	Comprehension-I	0	0	0	0	1
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
12	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	33	20	0	13	23.5

SEMESTER VI								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCCS601	PC	Compiler Design	3	3	0	0	3
2	U18PCCS602	PC	Object Oriented Software Engineering	3	3	0	0	3
3		PE	Programme Elective-II	3	3	0	0	3
4		PE	Programme Elective-III	3	3	0	0	3
5		OE	Open Elective-I	3	3	0	0	3
PRACTICAL								
6	U18PCCS6L1	PC	Compiler Design Laboratory	3	0	0	3	1.5
7	U18PCCS6L2	PC	Object Oriented Software Engineering Laboratory	3	0	0	3	1.5
8	U18PRCS6P1	EE	Term Paper	3	0	0	3	1
9	U18EECS6S2	EE	Soft Skill	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	30	17	0	15	20

SEMESTER VII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Programme Elective-IV	3	3	0	0	3
2		PE	Programme Elective-V	3	3	0	0	3
3		OE	Open Elective-II	3	3	0	0	3
4	U18PCCS701	PC	Big Data Analytics	3	3	0	0	3
5	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
6	U18PRCS7P1	EE	Project-I	6	0	0	6	3
7	U18PCCS7L1	PC	Big Data Analytics Lab	3	0	0	3	1.5
ACTIVITY BASED COURSES								
8	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
9	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	25	12	0	13	16.5

SEMESTER VIII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Programme Elective-VI	3	3	0	0	3
2		OE	Open Elective-III	3	3	0	0	3
3		OE	Open Elective-IV (MOOC)	2	2	0	0	2
PRACTICAL								
4	U18PRCS8P1	EE	Project-II	12	0	0	12	9
ACTIVITY BASED COURSE								
5	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	20	8	0	12	17

OVERALL CREDITS FOR THE PROGRAMME : 167

PROGRAMME ELECTIVE –I (Semester V)								
Sl.No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS011	Artificial Intelligence	Natural Language Processing	3	3	0	0	3
2	U18PECS012	Cyber Security	Network Information Security	3	3	0	0	3
3	U18PECS013	Data Science	Data Warehousing and Data Mining	3	3	0	0	3
4	U18PECS014	Computer Vision	Digital Image Processing	3	3	0	0	3
5	U18PECS015	High Performance Computing	Multicore Architecture	3	3	0	0	3
6	U18PECS016	Digital Transformation Engineering	Service Oriented Architectures	3	3	0	0	3

PROGRAMME ELECTIVE –II (Semester VI)								
Sl. No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS021	Artificial Intelligence	Neural Networks	3	3	0	0	3
2	U18PECS022	Cyber Security	Software and Application Security	3	3	0	0	3
3	U18PECS023	Data Science	Machine Learning	3	3	0	0	3
4	U18PECS024	Computer Vision	Pattern Recognition and Soft computing	3	3	0	0	3
5	U18PECS025	High Performance Computing	High performance Computer Architecture	3	3	0	0	3
6	U18PECS026	Digital Transformation Engineering	Software Process and Project Management	3	3	0	0	3

PROGRAMME ELECTIVE –III (Semester VI)								
Sl. No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS031	Artificial Intelligence	Case based Reasoning	3	3	0	0	3
2	U18PECS032	Cyber Security	Cyber Forensics	3	3	0	0	3
3	U18PECS033	Data Science	Data Analytics	3	3	0	0	3
4	U18PECS034	Computer Vision	Augmented Reality	3	3	0	0	3
5	U18PECS035	High Performance Computing	Parallel and Distributed Computing	3	3	0	0	3
6	U18PECS036	Digital Transformation Engineering	Software Architecture Design	3	3	0	0	3

PROGRAMME ELECTIVE –IV (Semester VII)								
Sl. No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS041	Artificial Intelligence	Advanced deep learning and computer vision	3	3	0	0	3
2	U18PECS042	Cyber Security	Ethical Hacking	3	3	0	0	3
3	U18PECS043	Data Science	Web Mining	3	3	0	0	3
4	U18PECS044	Computer Vision	Information Visualization	3	3	0	0	3
5	U18PECS045	High Performance Computing	Network Applications and Services	3	3	0	0	3
6	U18PECS046	Digital Transformation Engineering	Software Analysis and Testing	3	3	0	0	3

PROGRAMME ELECTIVE –V (Semester VII)								
Sl. No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS051	Artificial Intelligence	Cognitive modeling	3	3	0	0	3
2	U18PECS052	Cyber Security	Web Security	3	3	0	0	3
3	U18PECS053	Data Science	Data and Visual Analytics	3	3	0	0	3
4	U18PECS054	Computer Vision	Deep Learning in Computer Vision	3	3	0	0	3
5	U18PECS055	High Performance Computing	High Performance Computing Architecture	3	3	0	0	3
6	U18PECS056	Digital Transformation Engineering	Business Intelligence	3	3	0	0	3

PROGRAMME ELECTIVE –VI (Semester VIII)								
Sl. No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PECS061	Artificial Intelligence	Augmented Reality	3	3	0	0	3
2	U18PECS062	Cyber Security	Block Chain Technology	3	3	0	0	3
3	U18PECS063	Data Science	Big Data for Healthcare	3	3	0	0	3
4	U18PECS064	Computer Vision	Medical Imaging and Inverse Problems	3	3	0	0	3
5	U18PECS065	High Performance Computing	High Performance Computing Tools and Applications	3	3	0	0	3
6	U18PECS066	Digital Transformation Engineering	Enterprise Application Integration	3	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES
ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20. U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology

55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS001-Mobile Application Development
72. U18OECS002-System Modelling and Simulation
73. U18OECS003-Web Programming
74. U18OECS004-Virtual Reality
    U18OECS005- E Commerce
75. U18OEGE001-Metagenomics and Epigenomics
76. U18OEGE002-Molecular Genetics and Genomics
77. U18OEGE003-Principles of Molecular cell biology

HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	Communicative English	4	2	0	2	3
2	U18HSEN201	Technical English	3	2	1	0	3
Total Credits							**6**

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18ESEE101	Basic Electrical & Electronics Engineering	3	3	0	0	3
2	U18ESME101	Engineering Graphics & Design	5	1	0	4	3
3	U18ESCS101	Problem Solving and Python Programming	3	3	0	0	3
4	U18ESEC303	Digital Electronics	3	3	0	0	3
5	U18ESME1L2	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
6	U18ESEE1L3	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
7	U18ESCS1L1	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
8	U18ESEC3L1	Digital Electronics Laboratory	3	0	0	3	1.5
Total credits							**19.5**

PROFESSIONAL CORE COURSES (PC)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18PCCS301	Data Structures & Algorithm	3	3	0	0	3
2	U18PCCS302	Object Oriented Programming	3	3	0	0	3
3	U18PCCS303	Computer Organization & Architecture	3	3	0	0	3
4	U18PCCS401	Cloud Computing	3	3	0	0	3

5	U18PCCS402	Design and Analysis of Algorithm	3	3	0	0	3
6	U18PCCS403	Database Systems	3	3	0	0	3
7	U18PCCS404	Operating Systems	3	3	0	0	3
8	U18PCCS405	Formal Language and Automata Theory	3	3	0	0	3
9	U18PCCS501	Artificial Intelligence	3	3	0	0	3
10	U18PCCS502	Software Engineering	3	3	0	0	3
11	U18PCCS503	Functional Programming	3	3	0	0	3
12	U18PCCS504	Computer Networks	3	3	0	0	3
13	U18PCCS601	Compiler Design	3	3	0	0	3
14	U18PCCS602	Object Oriented Software Engineering	3	3	0	0	3
15	U18PCCS701	Big Data Analytics	3	3	0	0	3
16	U18PCCS3L1	Data Structures and Algorithm Laboratory	3	0	0	3	1.5
17	U18PCCS3L2	Object Oriented Programming Lab	3	0	0	3	1.5
18	U18PCCS4L1	Operating System Laboratory	3	0	0	3	1.5
19	U18PCCS4L2	Design and Analysis of Algorithm Laboratory	3	0	0	3	1.5
20	U18PCCS4L3	Database Systems Lab	3	0	0	3	1.5
21	U18PCCS5L1	Software Engineering Laboratory	3	0	0	3	1.5
22	U18PCCS5L2	Network Programming Laboratory	3	0	0	3	1.5
23	U18PCCS5L3	Functional Programming Laboratory	3	0	0	3	1.5
24	U18PCCS6L1	Compiler Design	3	0	0	3	1.5

		Laboratory					
25	U18PCCS6L2	Object Oriented Software Engineering Laboratory	3	0	0	3	1.5
26	U18PCCS7L1	Big Data Analytics Lab	3	0	0	3	1.5
Total Credits							**61.5**

MANDATORY COURSES (MC)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18BSCH401	Constitution of India	3	3	0	0	3
2	U18MCTH502	Universal Human Values	2	2	0	0	0
3	U18MCTH603	Essence of Indian Knowledge Tradition	2	2	0	0	0
1	U18MCAB101	Physical health – Sports & Games	2	0	0	2	0
2	U18MCAB102	Gardening & Tree Plantation -	2	0	0	2	0
3	U18MCAB203	Yoga	2	0	0	2	0
4	U18MCAB204	Physical health – NCC	2	0	0	2	0
5	U18MCAB305	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
7	U18MCAB407	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
8	U18MCAB408	Literature & Media – Group Reading of Classics	2	0	0	2	0
9	U18MCAB509	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	Social Services – NSS	2	0	0	2	0
11	U18MCAB611	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	Self Development - religion and Inter-faith	2	0	0	2	0
13	U18MCAB713	Behavioral and interpersonal skills	2	0	0	2	0
14	U18MCAB714	Nature – Nature club	2	0	0	2	0
15	U18MCAB815	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total Contact hours			**37**				

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management Courses (HS)	3	3			3				9	5.39%
2	Maths&Basic Sciences (BS)	12	13	4	4					33	19.76%
3	Engineering Sciences (ES)	7.5	7.5	4.5						19.5	11.68%
4	Professional Core (PC)			12	19.5	16.5	9	4.5		61.5	36.83%
5	Professional Electives (PE)					3	6	6	3	18	10.78%
6	Open Electives (OE)						3	3	3	9	5.39%
7	Massive Open Online Course(MOOC)								2	2	1.20%
8	Employment Enhancement Courses (EEC)					1	2	3	9	15	8.98%
9	Mandatory courses(MC)									0	
	Total Credit	22.5	23.5	20.5	23.5	23.5	20	16.5	17	167	
	Total Contact Hour	31	34	29	32	33	30	25	20		

U18HSEN101	COMMUNICATIVE ENGLISH	L	T	P	C
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)

6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable
CO6	To create formal letters, presentations and reports for conducting meeting, Interviews and competitive examinations.

MAPPING BETWEEN COURSE OUTCOMES&PROGRAMME OUTCOMES

COs\SOs	**a**	**b**	**c**	**d**	**E**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1								M		H	M	M
2								M		M	M	H
3										H	M	
4								M		H	M	M
5								M		H	M	M
6								M		H	M	M

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA101	**Engineering Mathematics – I**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and				

	applications that they would find useful in their disciplines.

UNIT I THEORY OF EQUATIONS (9+3)

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian–Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variables (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3)

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

EXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., Manickavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.

CO5	Identify Eigen value problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.
CO6	To choose and solve the problems in double and triple integrals.

CO/SO Mapping:: H-High, M-Medium, L-Low

COs	Programme Outcomes(POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	H	H		H								
CO2	H	H		H								
CO3	H	H		H								
CO4	H	H		H								
CO5	H	H		H								
CO6	H	H		H								

Category	Basic Science (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSPH101	**WAVES AND OPTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course Designed by – Department of Physics				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power.

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights.
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing.
CO3	Understand the propagation of light and geometrical optics.
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves.
CO5	Understand the concept of laser and its applications.
CO6	To evaluate the Laser advantages over other materials.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	H	M										
	CO2	H	M										
	CO3	H	M										
	CO4	H	M										
	CO5	H	M										
	CO6	H	M										
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming

and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nano chemistry, Types of nano materials: Nano particles, Nano chemistry in biology and medicines.
CO6	To design and develop the Conventional and non-conventional energy sources and energy storage device.

CO/SO Mapping: H – High, M – Medium, L-Low

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M										
CO2	H	M										
CO3	H	M										
CO4	H	M										
CO5	H	M										
CO6	H	M										
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18ESEE101	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

UNIT 1 DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transformations Theorem.

UNIT 2 AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT 3 ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer.

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half

wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

UNIT 5 DIGITAL ELECTRONICS 6

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", McGraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.
CO6	To design different kinds of circuits and Switches.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation**) H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H						M			
	CO2	H	M	H						M			
	CO3	H	M	H						M			
	CO4	H	M	H						M			
	CO5	H	M	H						M			
	CO6	H	M	H						M			
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSBT101	BIOLOGY FOR ENGINEERS	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector.

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins.

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System - types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis.

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips.

TEXT BOOKS:

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure.
CO2	To understand about biodiversity and its conservation.
CO3	To know the fundamentals of genetics and the immune system.
CO4	To create an awareness about human diseases.
CO5	To give a basic knowledge of the applications of transgenics.
CO6	To know the applications of bio systems in environment, medical and agricultural

	sectors.												
Mapping of Course Outcomes with Programme Outcomes(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M									
	CO2	H	M	M									
	CO3	H	M	M									
	CO4	H	M	M									
	CO5	H	M	M									
	CO6	H	M	M									
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSPH2L2	**WAVE OPTICS AND SEMI CONDUCTOR PHYSICS LABORATORY (Common to B.Tech-EEE, ECE, EIE, BME, CSE & IT)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart knowledge of practical Physics to the students.

Course Outcome (CO's)	
CO1	Understand the fundamental concept of optics.
CO2	Understand the concept of production of ultrasonic waves.
CO3	Understand the functions of semiconductor.
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves.
CO5	Understand the concept of laser and its applications.
CO6	To evaluate the Laser advantages over other materials.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M										
	CO2	H	M										
	CO3	H	M										
	CO4	H	M										
	CO5	H	M										
	CO6	H	M										
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Semiconductor Physics – Circuit branches

1) Determination of Band Gap
2) Zener diode characteristics
3) p-n junction diode Characteristics

3) Transistor Characteristics
5) V-I characteristics using LDR circuit
6) Carey Foster's Bridge

U18BSCH2L4	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				

OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments.

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization an well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method
CO6	To create molecular weight and degree of polymerization using Viscometer.

MAPPING OF COURSE OUTCOMES (COs) WITH PROGRAMME OUTCOMES(POs)
H – High, M – Medium, L-Low

COs	PROGRAMME OUTCOMES(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M										
CO2	H	M										
CO3	H	M										
CO4	H	M										

CO5	H	M										
CO6	H	M										

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESME1L2	**Workshop/Manufacturing Practices Lab (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations &power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice
2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fitting models.
3. Carpentry **(9 hours)**
   a) Preparation Lap joints.
   b) Mortise and Tenonjoints.
   c) Cross Half.
   d) Dove Tail.
4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
   Preparation of butt joints, lap joints and tee joints
5. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints
6. Demonstration **(6 Hours)**
   Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.
CO5	To compare the Laws of Coloumb friction, refrigeration systems, Velocity and acceleration.
CO6	To develop manufacturing methods encountered in engineering practice.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	3	2	2								
	CO2	3	2	2								
	CO3	3	2	2								
	CO4	3	2	2								
	CO5	3	2	2								
	CO6	3	2	2								
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter

6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law.
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator.
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor.
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flops.

Mapping of Course Outcomes (COs) with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H						M			
	CO2	H	M	H						M			
	CO3	H	M	H						M			
	CO4	H	M	H						M			
	CO5	H	M	H						M			
	CO6	H	M	H						M			
3	Category	Engg. Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	0	2
	Prerequisite – I Semester English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.
CO6	To develop a reasonably good level of competency in public speaking

Mapping of Course Outcomes (COs) with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs\POs	a	b	c	d	e	f	g	h	i	j	k	l
1								M		H	M	M
2								M		H	M	M
3								M		H	M	M
4								M		H	M	M
5								M		H	M	M
6								M		H	M	M

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

	ENGINEERING MATHEMATICS -II	L	T	P	C
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.
CO6	To formulate mathematical models for solving real world problems.

CO/PO Mapping:S – Strong, M – Medium, W – Weak

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H		H								
CO2	H	H		H								
CO3	H	H		H								
CO4	H	H		H								
CO5	H	H		H								
CO6	H	H		H								
Cate	Basic Science (BS)											
App	47th Academic Council Meeting held in Aug, 2018											

U18BSPH202	SEMICONDUCTOR PHYSICS	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES

- To develop physics and engineering strategies of semiconductor materials and to discuss their functionalities in modern electronic and optoelectronic devices

UNIT1 INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS 9

Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential:Kronig - penny and nearly free electron models - Real methods for band structure calculations; Band gaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands.

UNIT2 CARRIERS AND DOPING 9

Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration – intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Band gap engineering

UNIT 3 ELECTRICAL TRANSSORT 9

Scattering Mechanism: electron - electron and electron – phonon scattering. Macroscopic transport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field and very high field.

UNIT 4 OPTICAL TRANSSORT 9

Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties. Carrier transport - continuity equations. Optical constants: Kramers - Kronig relations.

UNIT 5 SEMICONDUCTOR AS DEVICES AND RECENT ADVANCES 9

Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductor junctions - Homo and hetero Junctions. Active and passive optoelectronic devices: performance and response enhancement (photo processes)**.**

TEXT BOOK:

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014**(for units 1 and 2)**
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 5)

REFERENCES BOOKS:

1) Kevin F Brennan, "The Physics of Semiconductors", Cambridge Univ.Press 1999.
2) Peter Y Yu and Manuel Cardona, "Fundamentals of Semiconductors",Spriger, 1996.
3) Charles Kittel, "Introduction to Solid State Physics", 6th edition, Willey, 1991.
4) D.A. Neamen, "Semiconductor Physics and Devices", 3 rdEd.,Tata McGraw-Hill,2002.
5) Jasprit Singh, "Semiconductor Optoelectronics (Physics and Technology)", McGraw-Hill, 1995.
6) Online reference: Wikipedia, NPTEL.

Course Outcome (COs)													
CO1	Understand the difference between metals, semiconductors and insulators												
CO2	Understand the importance of doping to charge carrier density												
CO3	Understand the electrical transport in semiconductors												
CO4	Understand the difference between direct and indirect semiconductors												
CO5	Understand the concept of semiconductor optoelectronic devices.												
CO6	To design novel engineering materials and its characteristics.												
Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M									
	CO2	H	M	M									
	CO3	H	M	M									
	CO4	H	M	M									
	CO5	H	M	M									
	CO6	H	M	M									
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	1	0	0
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL SOLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel – oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes
CO6	Understand Human population: population growth, variation among nations.

CO/SO Mapping: H-High, M-Medium ,L-Low

COs	**PROGRAMME OUTCOMES(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									
CO5	H	M	M									
CO6	H	M	M									

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

UNIT 1 ALGORITHIMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

UNIT 2 DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

UNIT 3 CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return

values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT 4 LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters;Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods;advanced list,Processing list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT 5 FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updatedfor Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems
CO6	To Understand Matplotlib,Scipy and Numpy.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	
2	CO1	M		M		M				M				
	CO2	M		M	H	M				M				
	CO3	M		M	H	M				M				
	CO4	M		M		M				M				
	CO5	M		M		M				M				
	CO6	M		M	H	M				M				
3	Category	Engg .Sciences (ES)												
4	Approval	47th Meeting of Academic Council held in Aug, 2018												

U18ESME101	ENGINEERING GRAPHICS & DESIGN	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice.				

SYLLABUS

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP;

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4:SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale –Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.
CO6	To apply Computer Graphics and techniques like Drawing sectional views of prism, pyramid, cylinder and cone.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation**) H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M		M									
	CO2	M		M									
	CO3	M		M									
	CO4	M		M									
	CO5	M		M									
	CO6	M		M									
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)

3. ExSOnentiation (SOwer of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib
CO6	To Understand about Simulate bouncing ball using Pygame.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	K	l
2	CO1	M		M		M				M			
	CO2	M		M	H	M				M			
	CO3	M		M	H	M				M			
	CO4	M		M		M				M			
	CO5	M		M		M				M			
	CO6	M		M	H	M				M			
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSMA303	**PROBABILITY AND STATISTICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – Basic knowledge in probability and statistics				
	Course Designed by : Department of Mathematics				
OBJECTIVE	This course aims at providing the required skill to apply the statistical tools in engineering problems.				

UNIT I PROBABILITY AND RANDOM VARIABLES (9+3)

Probability concepts, Random Variables, discrete and continuous functions of random variables. Moment generating function of Binomial, Poisson, Geometric, Uniform, Exponential and Normal distribution (Problems)

UNIT II TWO DIMENSIONAL RANDOM VARIABLES (9+3)

Joint distributions - Marginal and Conditional distributions – Expectation and conditional expectations. Transformation of Random Variable, Central limit theorem (for independent and identically distributed random variables)

UNIT IIIBASIC STATISTICS (9+3)

Measures of central tendency – Measures of dispersion – Moments, Skewness & Kurtosis – Correlation, and Regression and Rank Correlation.

UNIT IVTESTING OF HYPOTHESIS (9+3)

Introduction – Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportions, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, independence of attributes.

UNIT V ANALYSIS OF VARIANCE (9+3)

Small sample tests based on T and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances, ANOVA– one –way classification, Two-way classification.

TEXT BOOKS

(1) S.C.Gupta&V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi,2003. [Units I to III].

(2) S.C. Gupta and V.K. Kapoor, "Applied Statistics". Sultan Chand and Sons, New Delhi 2004 [UnitsIV& V].

(3) Douglas C. Montgomory. "Design and Analysis of Experiments, Student Solutions Manual", 8thEdn: Wiley India Pvt Ltd., New Delhi-2. 2012.

REFERENCE BOOKS

1. Veerarajan T. "Probability Statistics and Random Processes" Tata McGraw Hill, New Delhi 2003.
2. W.W. Daniel, "Biostatistics-A foundation for Analysis of Health Sciences", John Wiley and Sons, New Delhi 2000.
3. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability for Engineers", 6thEdn. Wiley India Pvt Ltd., New Delhi-2. 2010.
4. Tirupathi R.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

COURSE OUTCOMES (COs)	
CO1	To Understand the importance and the application of Probability in Engineering.
CO2	To make students understand Discrete and Continuous Random variables, Random Processes and their Applications.
CO3	To Understand Various tools for testing the parameters based on samples
CO4	The techniques of sampling, and estimating and testing the parameters.
CO5	To Design of Experiments are to be analysed.
CO6	To Evaluate Small sample tests based on T and F distribution.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H		H								
CO2	H	H		H								
CO3	H	H		H								
CO4	H	H		H								
CO5	H	H		H								
Category	Basic Science (BS)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCCS301	**DATA STRUCTURES& ALGORITHM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisites –Problem Solving & Python Programming				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

This course demonstrates familiarity with major algorithms and data structures and analyzes performance of algorithms. It is used to choose the appropriate data structure and algorithm design method for a specified application and determine which algorithm or data structure to use in different scenarios.

UNIT- I INTRODUCTION **9**

Data objects and structures – Performance analysis- Space complexity – Time complexity- Classification of data structures -The linear list data structure -Implementation of List data Structures- Singly linked list– Circular lists- Doubly liked list.

UNIT- II STACKS AND QUEUES **9**

Stacks – Abstract Data Type - Array Representation – Linked representation - Stack operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation– Queue - Queue ADT, Types of Queue: Simple Queue, Circular Queue, Priority Queue - Queue Representation - Operations on each types of Queues: Algorithms.

UNIT- III TREES **9**

Trees - Tree Terminologies, Different types of Trees – Binary trees – Properties of binary trees – Representation of binary trees – Binary tree traversal –Heap – Binary search tree- Binary search tree implementations –AVL trees-Threaded Binary Tree-B Tree, B+ Tree – Splay tree – Applications.

UNIT- IV GRAPH **9**

Graph- Basic Terminologies – Representations- Graph types - Graph search methods - Graph traversal algorithms - complexity analysis– Applications of Graph.

UNIT- VSORTING AND HASHING **9**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

TEXT BOOKS:

1. SartajSahni, "Data Structures, Algorithms and Applications in C++", Second Edition, Universities Press.2005.
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, SartajSahni, and Computer Science Press.

REFERENCES:

1. Horowitz, Sahni, Mehta, "Fundamentals of Data Structures in C++", 2nd Edition, Universities Press, 2007.
2. A.V.Aho, Hopcroft, Ullman, "Data Structures & Algorithms", Pearson Education, 2005.
3. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
4. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
5. http://lib.mdp.ac.id/ebook/Karya%20Umum/Dsa.pdf

COURSE OUTCOMES (COs)	
CO1	Explain the basic data structures and its operations.
CO2	Explain the concept of time complexity and space complexity.
CO3	Identify an appropriate data structure for a problem.
CO4	Make use of basic data structures to solve problems.
CO5	Summarize various searching and sorting algorithms.
CO6	To Understand the concept of various data representation.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									
CO5	H	M	M									
CO6	H	M	M									
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCCS302	OBJECT ORIENTED PROGRAMMING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisites –Problem Solving and Python Programming				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

- The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, and an appropriate framework for automated unit and integration tests.
- To develop programming skill and to solve engineering related problems using Object Oriented Programming Concepts.

UNIT 1 INTRODUCTION TO OOP CONCEPTS 9

Procedure Oriented Programming - Object-Oriented Paradigm – Benefits - Applications - Features of OOP – C++ Fundamentals - Data Types – Operators and Expressions – Control Structures – Arrays and Strings – Modular Programming with Functions – Storage Classes – Structures and Unions – Pointers and Runtime Binding.

UNIT 2 PROGRAMMING IN C++ 9

Classes and Objects – Constructors and Destructors – Operator Overloading – Inheritance – Virtual Functions and Polymorphism – Data Abstraction – Encapsulation - Templates – Exception Handling - C++ Stream Classes – I/O Operations – File Classes and Operations

UNIT 3 C++ ADVANCED FEATURES 9

Dynamic Memory –Memory Management-New and Delete Operator-Pointer to Objects-Debugging Pointer- C++ Web Programming – Object Modeling and Object Oriented Software Development.

UNIT 4 INTRODUCTION TO JAVA 9

Overview of Java – Features - JDK, JRE, JVM – Data Types – Variables – Arrays – String – Wrapper Classes – Operators – Control Statements – Java Objects and Classes – Inheritance and Aggregation – Polymorphism: Method Overloading, Method Overriding – Constructors: Default, Parameterized, Static and This Keyword – Garbage Collector – Java Regex.

UNIT 5 PROGRAMMING IN JAVA 9

Packages – Abstract Classes – Interfaces and Inner classes – Exception Handling – Memory Management – Multithreading – File Handling – Streams and I/O – Applets – Design Patterns – Iterator Pattern – Model View Controller Pattern – Generic Programming – Java Collections – Java GUI: Abstract Window Toolkit, Swing, Scala.

TEXT BOOKS

1. Paul Deital, Harvey Deital, "C++ How to Program", 10th Edition, Pearson, 2016.
2. K R Venugopal, "Mastering C++", 25th Reprint , Tata McGraw Hill, 2006.
3. Herbert Schildt, " Java The Complete Reference", 11th Edition, Tata McGraw Hill Education, 2017.

REFERENCES

1. Balagurusamy. E, "Object Oriented Programming with C++", 5th Edition, McGraw Hill, 2008.
2. http://www.cplusplus.com/articles/cpp11
3. https://www.tutorialspoint.com/cplusplus/index.htm

4. Ali Bahrami, "Object Oriented System Development", Tata McGraw-Hill Education, 2008.
5. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001.

COURSE OUTCOMES (COs)	
CO1	Specify simple abstract data types and design implementations, using abstraction functions to document them
CO2	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
CO3	Name and apply some common object-oriented design patterns and give examples of their use
CO4	Design applications with an event-driven graphical user interface
CO5	Understand basic knowledge about Java Programming
CO6	Learn various packages in Java.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	M									
CO2	H	H	M									
CO3	H	H	M									
CO4	H	H	M									
CO5	H	H	M									
CO6	H	H	M									
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U**18PCCS303**	**COMPUTER ORGANIZATION AND ARCHITECTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Computer Fundamentals				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

To expose the students to the following :

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on micro programming
- To study the basics of hardwired and micro programmed design.

UNIT-I ARCHITECTURE FUNDAMENTALS 9

Functional units – CPU Registers–CPU Organization- Memory operations –Instruction Format – Addressing modes – Basic I/O operations-Evaluating CPU Performance-Data representation-signed number representation, fixed and floating point representations, character representation.

UNIT-II CPU ARCHITECTURE 9

Instruction sets of different machines –Parallel Processing- Flynn's Classification- Pipelining-

Arithmetic Pipeline-Instruction Pipeline- -Pipelining Hazards- CISC Vs RISC - Super Scalar Architecture -overview of hardwired and micro programmed design.

UNIT-III MEMORY SYSTEM 9

Basic concepts – Different Types of Memory-Memory Hierarchy- Semiconductor RAMs – ROMs – Speed, Size and cost –Cache Memory-Mapping Techniques-Virtual memory-Evaluating Memory Performance-Secondary Storage.

UNIT-IV I/O ORGANIZATION 9

Input-Output Interface-I/O Performance Measures-I/O Modes of Transfer-Direct Memory Access-Input Output Processor-Interfacing to different types of I/O devices-I/O device interfaces – SCSI& USB.

UNIT-V PARALLEL ARCHITECTURE 9

Introduction to parallel processors - Multiprocessor- Data flow –Static Dataflow-Dynamic Dataflow-Dataflow Graph-Vector Processors – CRAY-1 Vector Processor-EPIC.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, "Computer Architecture-A Quantitative Approach", Elsevier, a division of reed India Private Limited, 5thedition, 2012.

2. M. Mano, "Computer System Architecture", Third Edition, Pearson Education,2008.
3. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization",McGraw-Hill, 5th Edition, Reprint 2012.

REFERENCES:

1. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
2. John P. Hayes, "Computer Architecture and Organization", Tata McGraw Hill,3rd Edition, 1998
3. http://www.genrica.com/vustuff/CS501/CS501_handouts_1_45.pdf.

COURSE OUTCOMES (COs)	
CO1	Explain the organization and working principle of computer hardware components.
CO2	Explain the hierarchical memory system and data transfer with in a digital computer.
CO3	Outline the operation of arithmetic unit.
CO4	Summarize the execution sequence of an instruction through the processor
CO5	Explain the ways of communication between a processor and I/O devices.
CO6	Explain the concept of Parallel Architecture.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	
COs	**Programme Outcomes(POs)**

	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H									
CO2	H	H	H									
CO3	H	H	H									
CO4	H	H	H									
CO5	H	H	H									
CO6	H	H	H									
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEC303	**DIGITAL ELECTRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Basic Computer and Electronics Knowledge				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

- To get a basic understanding of how circuits and systems are designed with digital electronic circuit elements.
- To be able to analyze and design circuits and systems made from digital electronic circuit elements such as gates and flip-flops.
- To master basic design and programming of simple computers.

UNIT-I NUMBER SYSTEMS AND CODES 9

Review of binary, octal and Hexa decimal representations of numbers and their conversion, Binary arithmetic; conversion algorithms. Weighted binary codes. Non weighted binary codes error-detecting and error-correcting codes-Alphanumeric codes.

UNIT-II BOOLEAN ALGEBRA 9

Introduction to Boolean algebra- The AND, OR and not operations. Laws of Boolean algebra of Boolean expressions. Boolean expressions and logic diagrams. Universal building blocks. Negative logic.

UNIT-III COMBINATIONAL LOGIC9

Truth tables and maps. Sum of products and product of sums; Map reduction hybrid functions. Incompletely specified functions. Multiple- Output minimization. Variable- Entered maps. Tabular minimization. analysis of logic schematics. Synthesis of combinational functions.

UNIT-III LOGIC FUNCTION RELIZATION WITH MSI CIRCUITS 9

Multiplexers, De-multiplexers, Decoders and code converters. Arithmetic circuits, Adder, Number complements. Subtracting positive binary numbers with adders. Signed number addition and subtraction.

UNIT-IV SYNCHORONOUS SEQUENTIAL CIRCUITS 9

Basic latch circuits, De-bouncing switch. Flip-flops, truth table and excitation table. Shift registers. Asynchronous and synchronous counters. Shift counters.

UNIT-V ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis and Design of Asynchronous Sequential Circuits , Reduction of State and Flow Tables ,Race-free State Assignment, Hazards.

TEXT BOOKS:

1. T. L Floyd & Jain, “Digital fundamentals”, Pearson Education,3rd edition,2011.
2. Morris Mano M., “Digital Logic and Computer Design”, Pearson Education,2010.

REFERENCE BOOKS:

1. Heiser Man, “Digital IC applications”, Pearson Education,2007.
2. Raj Kamal, “Digital Systems Principles and Design”, Pearson Education, First Edition, 2007.
3.CharlesH.Roth, Jr. and Larry L. Kinney, “Fundamentals of Logic Design”, CL Engineering, 7th Edition, 2013.
4.WilliamH.Gothmann, “Digital electronics: an introduction to theory and practice”,Prentice-Hall,2006 .
5.http://www.b-u.ac.in/sde_book/digi_com.pdf

COURSE OUTCOMES (COs)	
CO1	Perform arithmetic operations in any number system.
CO2	Understand the hierarchical memory system and data transfer with in a digital computer.
CO3	Use Boolean simplification techniques to design a combinational hardware circuit.
CO4	Understand the concept of number system.
CO5	Learn the various gates like AND, OR, NOT, XOR.
CO6	Learn the concept of synchronous and asynchronous sequential circuits.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	M	H	M								
CO2	M	M	H	M								
CO3	M	M	H	M								
CO4	M	M	H	M								
CO5	M	M	H	M								
CO6	M	M	H	M								
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCCS3L1	**DATA STRUCTURES & ALGORITHM LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite – Data Structures & Algorithm				
	Lab Manual Prepared by – Dept. of Computer Science & Engineering				

OBJECTIVES

This course demonstrates familiarity with major algorithms and data structures and analyzes performance of algorithms. It is used to choose the appropriate data structure and algorithm design method for a specified application and determine which algorithm or data structure to use in different scenarios.

LIST OF EXPERIMENTS:

1. Control Structures (Biggest Among three Numbers, Sum of Digits, Fibonacci Series, Arithmetic Calculator)

2. Functions(Factorial of a Number, sorting)

3.Aggregate Data Type(Manipulation of Unions, Manipulation of Structures)

4.File Handling(Creating File, Reading file and Merging File)

5. Implementation of Linked List(Singly Linked List)

6. Implementation of Linked List(Doubly Linked List)

7. Implementation of Stack(Using Array, Linked List)

8. Implementation of Queue(Using Array, Linked List)

9.Implementation of Trees

10.Implementation of Searching Algorithms(Binary Search, Linear Search)

11.Implementation of Sorting Algorithms(Quick sort)

12.Implementation of sorting algorithms(Insertion sort, Selection sort)

13.Control Structures (Biggest Among Three Numbers, Sum of Digits, Fibonacci Series, Arithmetic Calculator)

14.Functions (Factorial of a Number, sorting)

15.Aggregate Data Type (Manipulation of Unions, Manipulation of Structures)

16. File Handling (Creating File, Reading file and Merging File)

17.Implementation of Linked List(Singly Linked List)

18.Implementation of Linked List(Doubly Linked List)

19.Implementation of Stack(Using Array, Linked List)

20.Implementation of Queue(Using Array, Linked List)

21.Implementation of Trees

22.Implementation of Searching algorithms(Binary Search, Linear Search)

23. Implementation of Sorting algorithms (Quick sort)

24. Implementation of Sorting algorithms (Insertion sort, Selection sort)

COURSE OUTCOMES (COs)	
CO1	Implement various basic data structures and its operations.
CO2	Implement various sorting and searching algorithms.
CO3	Implement various tree operations.

CO4	Implement various graphs algorithms.
CO5	Develop simple applications using various data structures.
CO6	Develop algorithms using various searching and sorting techniques.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									
CO5	H	M	M									
CO6	H	M	M									
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PCCS3L2	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisites –Object Oriented Programming				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

- The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, and an appropriate framework for automated unit and integration tests.
- To develop programming skill and to solve engineering related problems using Object Oriented Programming Concepts.

LIST OF EXPERIMENTS

PROGRAMMING IN C++

1. Program using Functions
   - Functions with Default arguments, Friend Function, Inline Function
   - Implementation of Call by Value, Address, Reference
2. Simple classes for understanding objects, member functions, constructors, destructor, copy constructor.
   - Classes with Primitive Data Members
   - Classes with Arrays as Data Members
   - Classes with Pointers as Data Members
   - Classes with Constant Data Members
   - Classes with Static Member Functions
3. Compile Time Polymorphism
   - Operator Overloading
   - Function Overloading
4. Run Time Polymorphism

- Various Forms of Inheritance
- Virtual Functions
- Virtual Base Classes
- Templates

5. File Handling
   - Sequential Access
   - Random Access
   - Dynamic Memory Allocation

PROGRAMMING IN JAVA

Programs Illustrating

1. Various Data Types
2. Manipulating Strings
3. Various forms of Inheritance
4. Polymorphism: Method Overloading, Method Overriding
5. Exception Handling
6. Interfaces
7. Packages
8. Multithreading
9. Draw Various Shapes And Mouse Events Using Java Applets.
10. Window Based Application using Java Swing

COURSE OUTCOMES (COs)	
CO1	Specify simple abstract data types and design implementations, using abstraction functions to document them
CO2	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
CO3	Name and apply some common object-oriented design patterns and give examples of their use
CO4	Design applications with an event-driven graphical user interface
CO5	To Understand basic knowledge about Java Programming
CO6	To Learn various packages in Java.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	M									
CO2	H	H	M									
CO3	H	H	M									
CO4	H	H	M									
CO5	H	H	M									
CO6	H	H	M									
Category	Professional Core (PC)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESEC3L3	**DIGITAL ELECTRONICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	0	0	3	1.5

	Prerequisite – Basic Electrical and Electronics Engineering Lab
	Lab Manual Designed by – Department of Electronics& Communication Engineering

OBJECTIVES:

- To get a basic understanding of how circuits and systems are designed with digital electronic circuit elements.
- To be able to analyze and design circuits and systems made from digital electronic circuit elements such as gates and flip-flops.
  To master basic design and programming of simple computers.

LIST OF EXPERIMENTS:

1.Study of logic gates.

2. Design and implementation of adders and Subtractors using logic gates.

3. Design and implementation of encoder and decoder using logic gates.

4. Design and implementation of multiplexer and Dusing logic gates .

5. Design and implementation of 2-bit magnitude comparator using logic gates,

6. Design and implementation of 16-bit odd/even parity checker.

7. Design and implementation of Flip-flops using logic gates.

8. Design and implementation of code converters using logic gates.

9. Design and implementation of counters.

10. Design and Implementation of shift registers.

COURSE OUTCOMES (COs)	
CO1	To Learn the basics of gates.
CO2	Construct basic combinational circuits and verify their functionalities.
CO3	To Apply the design procedures to design basic sequential circuits.
CO4	Learn about counters.
CO5	Learn about Shift registers.
CO6	To understand the basic digital circuits and to verify their operation.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	M	H	M								
CO2	M	M	H	M								
CO3	M	M	H	M								
CO4	M	M	H	M								
CO5	M	M	H	M								
CO6	M	M	H	M								
Category	Engineering Science (ES)											
Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSMA401	**DISCRETE MATHEMATICS**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				

OBJECTIVES	Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do use mathematically correct terminology and notation, construct correct direct and indirect proofs, apply logical reasoning to solve a variety of problems and introduce simple concepts in graph theory.

UNIT I MATHEMATICAL LOGIC (9+3)

Propositions and logic operators –Truth table – Equivalence – Implications – Tautologies – Laws of logic – Proofs in Propositional calculus – Inference theory – Predicate calculus.

UNIT II RELATION AND FUNCTIONS (9+3)

Different types of relations: Binary Relation – Partial Ordering Relation – Equivalence Relation – Sum and Product of Functions – bijective functions – Inverse and Composite Function.

UNIT III RECURRENCE RELATIONS (9+3)

Recurrence relations – solving recurrence relation – Homogeneous and non–homogeneous recurrence relation – Generating Functions – Groups – Properties – cyclic groups and subgroups cosets – Lagrange's theorem.

UNIT IV GRAPH THEORY (9+3)

Introduction of Graphs – Graph terminology – Representation of Graphs – Connectivity – Euler and Hamilton path – Euler and Hamilton cycles – the Travelling sales man problem – Graph Isomorphism.

UNIT V BOOLEAN ALGEBRA (9+3)

Boolean algebra – Partial order Relations on Boolean algebra – Boolean homomorphism – Disjunctive and conjunctive normal forms – Boolean functions.

TEXT BOOKS

1. Tremblay J.P and Manohar. R, "Discrete Mathematical Structures with Application to Computer Science", McGraw Hill Book Company, International Edition, 1987
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw Hill Book Company 1999.

REFERENCE BOOKS

1. Ralph P., Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, New Delhi. 2008
2. Venkataraman M.K, Discrete Mathematics", The National Publishing Company 2000.
3. T. Veerarajan, "Discrete Mathematics", Mc Graw Hill Publications, 2006.

COURSE OUTCOMES (COs)	
CO1	Understand Proposition and Logic operators, Inference theory and Predicate Calculus
CO2	Use logical notation to define and reason about fundamental Mathematical Concepts such as sets relations, and functions.
CO3	Use logical notations to define and reason about steps in proportional and Predicate logic.

CO4	Expose to the concept of recurrence relations, generating functions, group, and cyclic groups, subgroups.
CO5	Understand the terminologies of graph and develop the given problems as graph networks and solve with techniques of graph theory.
CO6	To understand given graphs are isomorphic and Lattices.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H		H								
CO2	H	H		H								
CO3	H	H		H								
CO4	H	H		H								
CO5	H	H		H								
CO6	H	H		H								
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS401	**CLOUD COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Organization & Architecture				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their importance.

UNIT I UNDERSTANDING CLOUD COMPUTING 9

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services-Web-Based Application.

UNIT-II CLOUD ARCHITECTURE AND MODEL 9

Technologies for Network Based system-System Models for Distributed and Cloud Computing-NIST Cloud Computing Reference Architecture Cloud models: Characteristics-Cloud Models (IaaS, PaaS, SaaS)-Public vs. Private Cloud-Cloud Solutions-Cloud ecosystem-Service Management-Computing on demand.

UNIT-III CLOUD INFRASTRUCTURE 9

Architectural Design of compute and Storage Clouds-Layered Cloud Architecture Development-Design Challenges-Inter Cloud Resource Management-Resource Provisioning and Platform Deployment-Global Exchange of Cloud Resources.

UNIT-IV PROGRAMMING MODEL 9

Parallel and Distributed Programming Paradigms-Map Reduce-Twister and Iterative Map Reduce-Hadoop Library from Apache-Mapping Applications-Programming Support-Google

App Engine, Amazon AWS-Cloud Software Environments-Eucalyptus, Open Nebula, Open Stack, Aneka, CloudSim.

UNIT-V CLOUD SECURITY 9

Security Overview-Cloud Security Challenges and Risks-Software-as-a-Service-Security Security Governance-Risk Management-Security Monitoring-Security Architecture Design-Data Security-Application Security-Virtual Machine Security-Identity Management and Access Control-Autonomic Security.

TEXTBOOK:

1.Kai Hwang, Geoffrey C Fox,Jack G Dongarra "Distributed and Cloud Computing ,From parallel processing to the Internet of Things" Morgan Kaufmann Publishers,2012.

REFERENCE BOOKS:

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing Implementation, Management and Security", CRC Press, 2010
2. Toby Velte, Anthony Velte, Robert Elsenpeter,"Cloud Computing, A Practical Approach", TMH, 2009.
3. Kumar Saurabh,"Cloud Computing –Insights into New-Era Infrastructure ", Wiley India, 2011
4. George Reese, "Cloud Applications Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly.
5. https://eniac2017.files.wordpress.com/2017/03/distributed-and-cloud-computing.pdf.

COURSE OUTCOMES (COs)	
CO1	To Understand the fundamental principles of distributed computing.
CO2	To Understand how the distributed computing environments known as Grids can be built from lower level services.
CO3	To Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
CO4	To Analyze the performance of Cloud Computing.
CO5	Learn various Cloud Programming models.
CO6	To Understand the concept of Cloud Security.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						
CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Core (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS402	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Data Structures & Algorithm				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

The Course should enable the students to

- Analyze various computing problems and design algorithms.
- Analyze the time and space complexity of algorithms and compute efficiency.
- Knowledge about different algorithm design techniques for a given problem.
- Demonstrate a familiarity with major algorithms and data structures.
- Improve efficiency of existing algorithms using advanced techniques.

UNIT I FOUNDATIONS 9

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Types of problems, Basics of Data Structures, Analysis of non-recursive algorithms, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

UNIT II GREEDY METHOD AND DYNAMIC PROGRAMMING 9

Brute Force Approach – Greedy Algorithms: An Activity Selection Problem – Elements of Greedy Strategy – Huffman Codes – Theoretical Foundations of Greedy Method – A task scheduling problem - Knapsack Problem – Dynamic Programming: Assembly line Scheduling – Matrix Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence – Optimal Binary Search Tree – Knapsack problem – Travelling Salesman Problem.

UNIT III GRAPH AND TREE ALGORITHMS 9

Graph and Tree Algorithms: Traversal algorithms – Representation of graphs – Breadth First Search – Depth First Search – Transitive Closure – Topological Sort – Strongly Connected Components – Minimum Spanning Trees – Algorithms – Single Source Shortest Path Algorithms – All Pair Shortest Path Algorithms – Network Flow Algorithms.

UNIT IV BACKTRACKING AND BRANCH &BOUND TECHNIQUES 9

Backtracking : n Queens Problem – sum of subsets – graph coloring – Hamiltonian cycle – knapsack problem, Branch and Bound Technique: Knapsack Problem – Travelling Salesman Problem – Heuristics – Characteristics and their applications domains.

UNIT V ADVANCED TOPICS 9

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Approximation algorithms; Randomized algorithms; Class of problems beyond NP – P SPACE.

TEXT BOOKS

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

REFERENCE BOOKS

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms -- A Creative Approach, 3rd Edition, UdiManber, Addison-Wesley, Reading, MA.
4. https://mitpress.mit.edu/books/introduction-algorithms.
5. https://comsciers.files.wordpress.com/.../horowitz-and-sahani-fundamentals-of-computer.

COURSE OUTCOMES (COs)	
CO1	Analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
CO2	Analyze the algorithm and solve it by recurrence relations.
CO3	Describe the greedy paradigm and explain when an algorithmic design situation calls for it.
CO4	Describe when an algorithmic design situation calls for it. Derive and solve recurrence relation.
CO5	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
CO6	Apply graph and write the corresponding algorithm to solve the problems.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									
CO5	H	M	M									
CO6	H	M	M									
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS403	**DATABASE MANAGEMENT SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Data Structures and Algorithm				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.

UNIT -I INTRODUCTION 9

Introduction - Database System Applications-Purpose of Database Systems- View of Data- Data Abstraction- Instances and Schemas- Relational Databases - Database Design- Data

model- Integrity constraints -The Entity - Relationship Model - Transaction Management - Database Architecture - Data Storage and Querying - Database Users and Administrators.

UNIT-II RELATIONAL DATABASES 9

Introduction to Relational model - Structure of Relational Databases - Relational database design - keys - Database Schema and Schema Diagrams - Relational Query Languages - Relational algebra and Relational Operations - Relational calculus -Introduction to SQL - Overview of the SQL Query Language - Basic Structure of SQL Queries - Functional dependency -Normal Forms.

UNIT-III DATA STORAGE AND QUERYING 9

Storage and File Structure - File Organization - Indexing and Hashing- Ordered Indices- Static Hashing- Dynamic Hashing- Query Processing- Overview- Measures of Query Cost-Selection-Sorting- Join Operation- Evaluation of Expressions- Query Optimization- Overview-Transformation of Relational Expressions- Estimating Statistics of Expression Results.

UNIT-IV TRANSACTIONS 9

Transaction Concept-A Simple Transaction Model-Storage Structure-Transaction Atomicity and Durability-Transaction Isolation- Transaction Isolation Levels- Serializability-Transactions as SQL Statements-Concurrency Control- Lock-Based Protocols- Time Stamp-Based Protocols-Validation Based Protocols- Database recovery - Deadlock Handling.

UNIT-VDATABASE SECURITY AND OBJECT-BASED DATABASES 9

Database Security-Authentication, Authorization and access control - DAC, MAC and RBAC models –SQL Injection-Object based databases- Object oriented and object relational databases- Persistent Programming Languages-Object-Relational Mapping-Object-Oriented versus Object-Relational Databases – Logical and web databases-Overview of Data warehousing - Data mining techniques.

TEXT BOOKS:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
3. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

REFERENCE BOOKS:

1. C. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson Education, 8thEdition,2006.
2. ArunK.Pujari.,"Data Mining Techniques", Universities Press,2013.

COURSE OUTCOMES (COs)	
CO1	For a given query write relational algebra expressions for that query and optimize the developed expressions
CO2	For a given specification of the requirement design the databases using E R method and normalization.
CO3	For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
CO4	For a given query optimize its execution using Query optimization algorithms, For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
CO5	Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.
CO6	Understand about Database security and Object Oriented Databases.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	M	M				M			
CO2	H	H	H	M	M				M			
CO3	H	H	H	M	M				M			
CO4	H	H	H	M	M				M			
CO5	H	H	H	M	M				M			
CO6	H	H	H	M	M				M			
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS404	**OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Computer Organization & Architecture				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

Every computer professional should have a basic understanding of how an operating system controls the computing resources and provide services to the users. This course provides an introduction to the operating system functions, design and implementation.

UNIT – I INTRODUCTION **9**

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

UNIT – II PROCESSES **9**

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

UNIT – III IPC AND DEADLOCK **9**

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT – IV MEMORY MANAGEMENT **9**

Memory Management: Basic concept, Logical and Physical address map, Memory allocation – Contiguous Memory allocation – Fixed and variable partition – Internal and External

fragmentation and Compaction, Paging – Principle of operation – Page allocation – Hardware support for paging, Protection and Sharing, Disadvantages of Paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

UNIT – V FILE MANAGEMENT **9**

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

TEXT BOOKS:

1. Operating System Concepts Essentials, 9th Edition by Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

REFERENCS BOOKS:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates.

COURSE OUTCOMES (COs)	
CO1	Illustrate the operating system concepts and its functionalities.
CO2	To Create processes and threads.
CO3	To Develop algorithms for process scheduling.
CO4	To Design and implement file management system.
CO5	Illustrate various file and disk management strategies.
CO6	To Understand the concept about Virtual memory.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	H	M	M	M						
CO2	H	M	H	M	M	M						
CO3	H	M	H	M	M	M						
CO4	H	M	H	M	M	M						
CO5	H	M	H	M	M	M						
CO6	H	M	H	M	M	M						

Category	Professional Course (PC)
Approval	47th Academic Council Meeting held in Aug, 2018

U18PCCS405	**FORMAL LANGUAGES & AUTOMATA THEORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Programming for problem solving				
	Course Designed by : Dept. of Mathematics				

OBJECTIVES

- To understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.
- To be aware of Decidability and Un-decidability of various problems. Learn types of grammars.

UNIT I FUNDAMENTALS 9

Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers.

UNIT II FINITE AUTOMATA 9

NFA with ε-transitions - Significance, acceptance of languages. Conversions and Equivalence : Equivalence between NFA with and without ε transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output-Moore and Melay machines.

UNIT III REGULAR LANGUAGES AND GRAMMAR 9

Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets. Regular grammars-right linear and leftlinear grammars, equivalence between regular linear grammar and FA, inter conversion,Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings.

UNIT IV CONTEXT FREE GRAMMARS AND PUSH DOWN AUTOMATA 9

Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL. Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA,

UNIT V TURING MACHINE 9

Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines. Universal Turing Machine, un-decidability of posts. Correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problems.

TEXTBOOKS:

1. "Introduction to Automata Theory Languages and Computation". Hopcroft H.E. and Ullman J. D. Pearson Education
2. Introduction to Theory of Computation –Sipser 2nd edition Thomson

REFERENCES:

1. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
2. Introduction to languages and the Theory of Computation ,John C Martin, TMH

3. "Elements of Theory of Computation", Lewis H.P. & Papadimition C.H. Pearson /PHI.
4 Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekaran, 2nd edition, PHI.

COURSE OUTCOMES (COs)	
CO1	Identify the type of random variable and distribution for a given operational conditions.
CO2	Study and design appropriate queuing model for a given problem or system situation.
CO3	To understand and simulate appropriate application and distribution problems.
CO4	Differentiate and infer the merit of sampling tests.
CO5	Formulate and find optimal solution in the real life optimizing, allocation assignment problems involving conditions and resource constraints.
CO6	Understand about Turing machine and NP hard and Complete problems.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						
CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS4L1	**OPERATING SYSTEM LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite –Operating Systems				
	Lab Manual Designed by – Dept. of Computer Science and Engineering				
OBJECTIVES The main objective is students gain knowledge about various Operating System Memory management and Commands using in Operating system.					

LIST OF EXPERIMENTS

1. Working with basic Unix/ Linux commands.
2. Shell Programming.
3. Programs using the following system calls of Unix / Linux operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir
4. Programs using the I/O system calls of UNIX operating system (open, read, write)
5. Simulations of Unix / Linux commands like ls, grep, etc.
6. Simulation of scheduling algorithms (CPU and Disk).
7. Implementation of synchronization problems using Semaphore.
8. Simulation of basic memory management schemes.

9. Simulation of virtual memory management schemes.

10. Simulation of file systems.

COURSE OUTCOMES (COs)	
CO1	Demonstrate Unix / Linux commands.
CO2	Implement various commands using shell programming.
CO3	Implement various CPU scheduling algorithms.
CO4	Implement various disk scheduling algorithms.
CO5	Implement memory management techniques.
CO6	To Apply concept about File System.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	H	M	M	M						
CO2	H	M	H	M	M	M						
CO3	H	M	H	M	M	M						
CO4	H	M	H	M	M	M						
CO5	H	M	H	M	M	M						
CO6	H	M	H	M	M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS4L2	**DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	3	1.5
	Prerequisite: Design and Analysis of Algorithms				
	Course Designed by : Dept. of Computer Science And Engineering				

OBJECTIVE
The Objective is students should analyze various computing problems and design algorithms henceforth find its complexity and efficiency.

LIST OF EXPERIMENTS

1. Implement recursive algorithms using Divide-and-Conquer algorithmic techniques to analyze

i) Quick Sort ii) Merge Sort iii) Binary Search.

2. Implement and analyze Greedy method for

i) Minimum Spanning Tree problem.

ii) Shortest path problem using Dijkstra's algorithm.

3. Implement and analyze Dynamic programming method for Knapsack problem.

4. Implement the graph traversal techniques for Depth First Search and Breadth First Search.

5. Implement and analyze backtracking method for

i) Sum of Subsets problem and

ii) Graph Coloring problem.

6. Implement the branch and bound technique for Travelling Salesman problem and compare with Dynamic Programming.

7. Implement and analyze randomized algorithm for Hiring problem.

COURSE OUTCOMES (COs)	
CO1	For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms
CO2	For a given problem analyze the algorithm and solve it by recurrence relations.
CO3	Describe the greedy paradigm and explain when an algorithmic design situation calls for it.
CO4	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
CO5	Describe the backtracking, branch and bound techniques and analyse complexity and efficiency.
CO6	To Apply concepts like backtracking and Dynamic programming.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									
CO5	H	M	M									
CO6	H	M	M									
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS4L3	**DBMS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite –Database Management System				
	Lab Manual Designed by – Dept. of Computer Science and Engineering				
OBJECTIVES: The main objective is to make the students to gain knowledge about databases for storing the data and to share the data among different kinds of users for their business operations.					

LIST OF EXPERIMENTS

1. Data Definition, Manipulation of base tables and views
2. High level programming language extensions.
3. Front end tools.

4. Forms-Triggers-Menu Design.
5. Reports.
6. Database Design and implementation
7. An exercise using Open Source Software like MySQL.

COURSE OUTCOMES (COs)	
CO1	Develop database modeling for a problem.
CO2	Design a database using normalization.
CO3	Implement a data base query language.
CO4	Develop GUI using front end tool.
CO5	Develop a connection between frontend and database.
CO6	To understand Forms ,Triggers and Reports.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	M	M				M			
CO2	H	H	H	M	M				M			
CO3	H	H	H	M	M				M			
CO4	H	H	H	M	M				M			
CO5	H	H	H	M	M				M			
CO6	H	H	H	M	M				M			
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS501	**ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Analysis of Algorithms, Discrete Mathematics				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

The objective of this to learn the concepts of Artificial Intelligence such as enable the computers to perform intellectual tasks, problem solving, perception, understanding human communication.

UNIT I PROBLEMS AND SEARCH 9

What is artificial intelligence? - Problems, problem spaces and search – Searching strategies- Uninformed Search- breadth first search, depth first search, uniform cost seart, depth limited search, iterative deepening search, bidirectional search - Informed Search- Best first search, Greedy Best first search , A* search – Constraint satisfaction problem , Local searching strategies.

UNIT II REASONING 9

Symbolic Reasoning Under Uncertainty- Statistical Reasoning - Weak Slot-And-Filler-Structure - Semantic nets – Frames- Strong Slot-And-Filler Structure-Conceptual Dependency-Scripts- CYC.

UNIT III KNOWLEDGE REPRESENTATION 9

Knowledge Representation - Knowledge representation issues - Using predicate logic - Representing Knowledge Using Rules. Syntactic- Semantic of Representation – Logic & slot

and filler - Game Playing – Minimal search- Alpha beta cutoffs –Iteratic deepening planning – component of planning system – Goal stack planning.

UNIT IVNATURAL LANGUAGE PROCESSING 9

Natural Language Processing –Syntactic processing, semantic analysis-Parallel and Distributed AI-Psychological modeling- parallelism and distributed in reasoning systems – Learning - Connectionist Models – Hopfield networks, neural networks.

UNIT V EXPERT SYSTEMS 9

Common Sense –qualitative physics, commonsense Ontologies- memory organization -Expert systems –Expert system shells- explanation – Knowledge acquisition -Perception and Action – Real time search- robot architecture.

TEXT BOOKS

1. E laine Rich, Kevin Knight, "Artificial Intelligence", 3/e, Tata McGraw Hill, 2009.
2. R ussell , " Artificial intelligence :A modern Approach , Pearson Education ,3rd edition,2013

REFERENCE BOOKS

1.Artificial Intelligence and Expert system by V.Daniel hunt, Springer press,2011.
2.Nilsson N.J., "Principles of Artificial Intelligence", Morgan Kaufmann.1998.

COURSE OUTCOMES (COs)	
CO1	Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions.
CO2	Demonstrate awareness of informed search and exploration methods.
CO3	Explain about AI techniques for knowledge representation, planning and uncertainty Management.
CO4	Develop knowledge of decision making and learning methods.
CO5	Describe the use of AI to solve English Communication problems
CO6	To Understand Knowledge acquisition ,Perception and Action

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H	H			H			M
CO2	H	H	H	H	H	H			H			M
CO3	H	H	H	H	H	H			H			M
CO4	H	H	H	H	H	H			H			M
CO5	H	H	H	H	H	H			H			M
CO6	H	H	H	H	H	H			H			M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS502	**SOFTWARE ENGINEERING**	**L**	**T**	**P**	**C**

	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Fundamentals of Computing and Programming				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

This course is intended to provide the students with an overall view over Software Engineering and with insight into the processes of software development.

UNIT I INTRODUCTION 9

Introduction- Notion of Software as a Product – characteristics of a good Software Product. Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers.

UNIT II PROCESS MODELS AND PROGRAM DESIGN TECHNIQUES 9

Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model. Good Program Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics. Software Modeling Tools – Data flow Diagrams, UML and XML. Jackson System Development.

UNIT III VERIFICATION AND VALIDATION 9

Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs – Cyclomatic Complexity. Introduction to testing of Real-time Software Systems.

UNIT IV SOFTWARE PROJECT MANAGEMENT 9

Software Project Management: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management. Software Cost Estimation – underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation – Expert judgement, Delphi cost estimation, Work break-down structure and Process break-down structure, COCOMO and COCOMO-II.

UNIT V ADVANCED TOPICS 9

Advanced Topics: Formal Methods in Software Engineering – Z notation, Hoare‟s notation. Formalization of Functional Specifications – SPEC. Support environment for Development of Software Products. Representative Tools for Editors, Linkers, Interpreters, Code Generators, Debuggers. Tools for Decision Support and Synthesis, Configuration control and Engineering Databases, Project Management. Petrinets: Introduction to Design Patterns, Aspect-oriented Programming.

TEXT BOOKS:

1. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli, “Fundamentals of Software Engineering”, Pearson Education, 2003.
2.Roger Pressman S., “Software Engineering: A Practitioner's Approach”, 7thEdition, McGraw Hill, 2010.

REFERENCE BOOKS:

1. I. Sommerville, “Software Engineering”, Eighth Edition, Pearson Education, 2007
2. Pfleeger, “Software Engineering-Theory & Practice”, 3rd Edition, Pearson Education, 2009
3.http://www.vumultan.com/Books/CS605-SoftwareEngineeringPractitionerEApproachbyRogerPressman.pdf

COURSE OUTCOMES (COs)	
CO1	Explain the engineering aspects of software production
CO2	Explain the principles involved in various process models
CO3	Make use of suitable models through analysis of requirements and arrive at an appropriate software design.
CO4	Ensure the quality of software through testing
CO5	Explain software project management and software maintenance practices.
CO6	To understand various testing concepts.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	L	M		M	H	M	H
CO2	M	H	H	H	M	M					M	M
CO3	M	H	H	H	M	M					M	M
CO4	M	H	H	H	M	M					M	M
CO5	M	H	H	H	M	M					M	M
CO6	M	H	H	H	M	M					M	M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS503	FUNCTIONAL PROGRAMMING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Object Oriented Programming				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES
The Main objective of this course is to learn the basic concepts of functional programming languages like Haskell, Python and Jscript

UNIT I INTRODUCTION 9
The standard prelude and the Haskell libraries, Hugs commands , Modules, Hugs Session, Basic types and definitions, Designing and writing programs in Haskell , Recursion , Primitive recursion in practice General forms of recursion , Program testing.

UNIT II DATATYPES & GENERIC FUNCTIONS 9

Data types: Introducing tuples, lists and strings,Tuple type, Lists in Haskell , List comprehensions , A library database , Generic functions: polymorphism, Lists and list patterns ,Primitive recursion over lists, Finding primitive recursive definitions , General recursions over lists, Example: text processing.

UNIT III FUNCTIONS 9

Functions as values: Function-level definitions , Function composition , Functions as values and results , Partial application, The Program development, Algebraic types : Introducing algebraic types , Recursive algebraic types.

UNIT IV FUNCTIONAL JAVASCRIPT 9
Introducing Functional JavaScript, Why Functional Programming Matters, Functions as Units

of Abstraction, Encapsulation and Hiding, Functions as Units of Behavior, Data as Abstraction, First Class Functions, JavaScript's Multiple Paradigms.

UNIT V FUNCTIONAL PYTHON 9

Introducing Functional Python, Flow Controls: Encapsulation , Comprehensions , Recursion , Eliminating Loops, Callables: Named Functions and Lambdas , Closures and Callable Instances, Lazy Evaluation : The Iterator Protocol Module: Itertools, Higher-Order Functions: Utility Higher-Order Functions , The operator Module :The functools Module , Decorators.

TEXT BOOKS:

1. Simon Thompson, Haskell: The Craft of Functional Programming, Addison-Wesley, 2011
2. Michael Fogus, Functional JavaScript, O'Reilly Media, May 2013
3. David Mertz, Functional Programming in Python, O'Reilly Media, May 2015

REFERENCE BOOKS:

1. Richard Bird, Thinking Functionally With Haskell, Cambridge University Press, October 2014.
2. Anto Aravinth, Beginning Functional JavaScript, Apress, March 2017
3. Fabrizio Romano, Learning Python, Packt Publishing Limited, Dec 2015
4. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf

COURSE OUTCOMES (COs)	
CO1	Understand the fundamental concepts of Haskell programs
CO2	Use Haskell to solve simple practical problems
CO3	Develop programs using mathematical functions, Strings, Dictionary, Sets
CO4	Develop programs to handle files, identify objects & develop classes
CO5	Understand the basic concepts of JScript.
CO6	To Understand Functional Python, Flow Controls: Encapsulation

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	M		M							
CO2	H	H	M		M							
CO3	H	H	M		M							
CO4	H	H	M		M							
CO5	H	H	M		M							
CO6	H	H	M		M							
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

18PCCS504	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Internet Concepts				

	Course Designed by – Dept. of Computer Science and Engineering.

OBJECTIVES

Computer Networking is the vital part of any organization these days. This course provides a foundation to understand various principles, protocols and design aspects of Computer Networks and also helps to achieve the fundamental purpose of computer networks in the form of providing access to shared resources.

UNIT I FUNDAMENTALS AND PHYSICAL LAYER 9

Computer Network Developments- Network Terms and Components-Network Topology-Standards-ISO/OSI layers-TCP/IP layers-, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT II DATA LINK LAYER (LLC & MAC) 9

Logical Link Control : Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Multiple access protocols : Random Access Protocol, Controlled Access Protocol, Channelization Protocol.

UNIT III NETWORK LAYER 9

Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, ICMP, BOOTP and DHCP; Routing algorithm-Link state algorithm, Distance vector routing algorithm, Hierarchical routing algorithm; Routing in the Internet-RIP, OSPF,BGP; Broadcast & Multicast routing- DVMRP, PIM.

UNIT IV TRANSPORT LAYER 9

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; QoS Improving Techniques (Traffic Shaping, Admission Control And Resource Reservation).

UNIT V APPLICATION LAYER 9

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TEXT BOOKS

1. Data Communication and Networking, 5th Edition, Behrouz A. Forouzan, McGraw-Hill,2013.
2. Data and Computer Communication, 10th Edition, William Stallings, Pearson Prentice Hall India,2013.

REFERENCE BOOKS

1. Computer Networks, 5th Edition, Andrew S. Tanenbaum, Pearson New International Edition,2010.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India, 2013.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America,2010

COURSE OUTCOMES (COs)	
CO1	Explain data communication system, components and the purpose of layered architecture.

CO2	Illustrate the functionality of each layer of OSI and TCP/IP reference model.
CO3	Explain the data link layer and network layer protocols.
CO4	Outline the functions of transport layer protocols.
CO5	To Summarize application layer protocols.
CO6	To Understand various application Protocols.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	Programme Outcomes(POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						
CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18HSBA501	**ORGANIZATIONAL BEHAVIOR**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Universal Human Values				
	Course Designed by – Dept of Management Studies				

OBJECTIVES

1.Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups
4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behavior.

UNIT- I **9**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT- II **9**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT- III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT- IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT- V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

COURSE OUTCOMES (COs)	
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour.
CO2	Knowledge of the Interpersonal perception.
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Familiarity with the knowledge of types of Conflicts.
CO6	To Understand various application Organizational Behaviour.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1			M		H		M	H	M	L	L	M
CO2			M		H		M	H	M	L	L	M
CO3			M		H		M	H	M	L	L	M
CO4			H		H		M	H	M	L	L	M
CO5			H		H		M	H	M	L	L	M
CO6			H		H		M	H	M	L	L	M
Category	Professional Course (PC)											
Approval	48th Academic Council Meeting held in Aug, 2018											

U18PCCS5L1	**SOFTWARE ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite –Software Engineering ,Database Management System				
	Lab Manual Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

The objective of this Software Engineering Lab is to understand the software engineering methodologies for project development, to gain knowledge on various CASE tools for applying it in the software modeling and implementation, to prepare students for performing requirement analysis and design of variety of applications.

Prepare the following documents for each experiment and develop the software using software engineering methodology.

- **Problem Analysis and Project Planning** -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.
- **Software Requirement Analysis** - Describe the individual Phases/modules of the project and Identify deliverables.
- **Data Modeling** - Use work products – data dictionary, use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
- **Software Development and Debugging** – implement the design by coding
- **Software Testing** - Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor.

LIST OF EXPERIMENTS:

Academic Domain

1. Course Registration System
2. Student Marks Analyzing System

Railway Domain

3. Online Ticket Reservation System
4. Platform Assignment System for the Trains in a Railway Station

Medicine Domain

5. Expert System to prescribe the Medicines for the given Symptoms
6. Remote Computer Monitoring

Finance Domain

7. ATM System
8. Stock Maintenance

Human Resource management

9. Quiz System
10. E-mail Client system

COURSE OUTCOMES (COs)	
CO1	Perform requirement analysis and design requirements for solving / developing engineering problems.
CO2	Identify project scope, objectives, and perform data modeling.
CO3	Identify the deliverables in various phases of SDLC.
CO4	Implement solutions using modern tools.
CO5	Explain test plan, perform validation testing, coverage analysis.
CO6	To Understand various Design Concepts in Software Engineering.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	L	M		M	H	M	H
CO2	M	H	H	H	M	M					M	M
CO3	M	H	H	H	M	M					M	M
CO4	M	H	H	H	M	M					M	M
CO5	M	H	H	H	M	M					M	M
CO6	M	H	H	H	M	M					M	M

Category	Professional Course (PC)
Approval	47th Academic Council Meeting held in Aug, 2018

U18PCCS5L2	**NETWORK PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite –Computer Networks				
	Lab Manual Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES: This laboratory course is intended to make the students know about Networking Concepts and Protocols.

LIST OF EXPERIMENTS:

1. Create a socket (TCP) between two computers and enable file transfer between them.
2. Write a program to develop a simple Chat TCP application.
3. Write a program to develop a simple Chat UDP application.
4. Write a socket Program for Echo/Ping/Talk commands.
5. Implementation of Stop and Wait Protocol and Sliding Window Protocol.
6. Implementation of DNS, SNMP and File Transfer application using TCP and UDP Sockets.
7. Create a socket for HTTP for web page upload and download.
8. Write a program to display the client's address at the server end.
9. Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS
10. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer.
    i. Link State routing
    ii. Flooding
    iii. Distance vector

COURSE OUTCOMES (COs)	
CO1	Understand fundamental underlying of Socket Programming
CO2	Practice packet/file transmission between nodes.
CO3	Implementation of client-server applications
CO4	Analyze the performance of network protocols.
CO5	To Understand various Network Simulator
CO6	To apply various routing algorithms.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						
CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS601	**COMPILER DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Data Structures, Discrete Mathematics				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

The objective of this to learn the design of compiler Design, the various parsing techniques, how to optimize and effectively generate machine codes

UNIT I OVERVIEW OF COMPILATION AND SYNTAX ANALYSIS 9

The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs. Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and ambiguity, examples of programming language grammars.

UNIT II PARSING 9

Top-down parsing- FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications. Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, dependency graphs. S-attributed and L-attributed SDDs and their implementation using LR-parsers and recursive- descent parsers respectively.

UNIT III SEMANTIC ANALYSIS 9

Semantic analysis- Symbol tables and their data structures. Representation of“scope”. Semantic analysis of expressions, assignment, and control-flow statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery.

UNIT IV INTERMEDIATE CODE GENERATION 9

Intermediate code generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it- then-else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs.

UNIT V RUN-TIME ENVIRONMENTS 9

Run-time environments:- Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures. Introduction to machine code generation and optimization- Simple machine code generation, examples of machine-independent code optimizations.

TEXT BOOKS:

1. Compilers: Principles, Techniques, and Tools , by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman,(2nd ed.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2011

REFERENCE BOOKS:

1. K.C. louden, compiler construction: principles and practice, cengage learning,1997
2.D. Brown, J. Levine, and T. Mason, LEX and YACC, O"Reilly Media,1992
3.http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
4.http://ecomputernotes.com/compiler-design.

COURSE OUTCOMES (COs)	
CO1	Explain the phases of a Compiler
CO2	Illustrate the translation of regular expression into parse tree using syntax analyzer.
CO3	Construct the intermediate representation considering the type systems
CO4	Apply the optimization techniques for the generated code
CO5	Use the different compiler construction tools to develop a simple compiler
CO6	To create Compiler using Lex and YACC tools.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						
CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS602	**OBJECT ORIENTED SOFTWARE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Analysis of Algorithms, Discrete Mathematics				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES
The objective of this course is to learn the basic of object oriented analysis and design skills, UML design diagrams and various testing techniques.

UNIT I OBJECT ORIENTED METHODOLOGIES 9
Introduction to System Concepts - Managing Complex Software — Properties – Object Oriented Systems Development – Object Basics – Systems Development Life Cycle - Rumbaugh Methodology - Booch Methodology - Jacobson Methodology – Unified Process.

UNIT II UML 9
Unified Approach – Unified Modeling Language – Static behavior diagrams – Dynamic behavior diagrams – Object Constraint Language.

UNIT III DESIGN CONCEPTS 9
Inception – Evolutionary Requirements – Domain Models – Operation Contracts - Requirements to Design – Design Axioms – Logical Architecture - Designing Objects with

Responsibilities – Object Design – Designing for Visibility.

UNIT IV DESIGN PATTERNS 9

Patterns – Analysis and Design patterns – GoF Patterns - Mapping designs to code – Test Driven development and refactoring – UML Tools and UML as blueprint.

UNIT V ARCHITECTURE ANALYSIS 9

More Patterns – Applying design patterns – Architectural Analysis – Logical Architecture Refinement – Package Design – Persistence framework with patterns.

TEXT BOOKS

1. Booch, Grady. Object Oriented Analysis and Design. 2nd edition, Pearson Education. 2006.
2. Ali Bahrami, " Object Oriented Systems Development", Tata McGraw Hill, 2008.

REFERENCES

1. Craig Larman. "Applying UML and Patterns – An introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd ed, Pearson Education, 2005.
2. Fowler, Martin. UML Distilled. 3rd edition. Pearson Education. 2004.
3. Michael Blaha and James Rumbaugh, "Object-oriented modeling and design with UML", Prentice-Hall of India, 2005.
4. https://www.cs.ucsb.edu/~mikec/cs48/project/ProcessLarman.pdf

COURSE OUTCOMES (COs)	
CO1	Design and implement projects using OO concepts
CO2	Use the UML analysis and design diagrams
CO3	Apply appropriate design patterns.
CO4	Create code from design.
CO5	Compare and contrast various testing techniques.
CO6	To Applying design patterns.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	M						
CO2	M	H	H	H	M	M						
CO3	M	H	H	H	M	M						
CO4	M	H	H	H	M	M						
CO5	M	H	H	H	M	M						
CO6	M	H	H	H	M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS6L1	**COMPILER DESIGN LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite – Compiler Design, C Programming				

OBJECTIVES

This laboratory course is intended to make the students experiment on the basic techniques of compiler construction and tools that can used to perform syntax-directed translation of a high-level programming language into an executable code. Students will design and implement language processors in C by using tools to automate parts of the implementation process. This will provide deeper insights into the more advanced semantics aspects of programming languages, code generation, machine independent optimizations, dynamic memory allocation, and object orientation.

List of Experiments:

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Write a C program to recognize strings under 'a', 'a*b+', 'abb'.
4. Write a C program to test whether a given identifier is valid or not.
5. Write a C program to simulate lexical analyzer for validating operators.
6. Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools
7. Write a C program for implementing the functionalities of predictive parser for the mini language specified in Note 1.
8. a) Write a C program for constructing of LL (1) parsing.
   b) Write a C program for constructing recursive descent parsing
9. Write a C program to implement LALR parsing
10. a) Write a C program to implement operator precedence parsing.

b)Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value

11.Convert the BNF rules into Yacc form and write code to generate abstract syntax tree for the mini language specified in Note 1.

12. Write a C program to generate machine code from abstract syntax tree generated by the parser. The instruction set specified in Note 2 may be considered as the target code.

COURSE OUTCOMES (COs)	
CO1	To Understand the working of lex and yacc compiler for debugging of programs.
CO2	To Understand and define the role of lexical analyzer, use of regular expression and transition diagrams.
CO3	To Understand and use Context free grammar, and parse tree construction.
CO4	To Learn & use the new tools and technologies used for designing a compiler.
CO5	To Develop program for solving parser problems.
CO6	To generate machine code from abstract syntax tree generated by the parser.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H		M	M						
CO2	H	H	H		M	M						
CO3	H	H	H		M	M						
CO4	H	H	H		M	M						

CO5	H	H	H		M	M						
CO6	H	H	H		M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS6L2	**OBJECT ORIENTED SOFTWARE ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite – Software Engineering				
	Lab Manual Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

This laboratory course is intended to make the students know about basic concepts of Object Oriented Analysis and Design.

LIST OF EXPERIMENTS:

1. Passport automation system.
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Software personnel management system
8. Credit card processing
9. E-book management system
10. Recruitment system
11. Foreign trading system
12. Conferencemanagement System
13. BPO management System
14. Library management system
15. Student information system

COURSE OUTCOMES (COs)	
CO1	To capture the requirements specification for an intended software system
CO2	To draw the UML diagrams for the given specification
CO3	To Apply the design pattern properly in .
CO4	To test the software system thoroughly for all scenarios.
CO5	To improve the design by applying appropriate design patterns.
CO6	To analyze the concept of patterns for constructing software architectures.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	M						
CO2	M	H	H	H	M	M						
CO3	M	H	H	H	M	M						
CO4	M	H	H	H	M	M						
CO5	M	H	H	H	M	M						
CO6	M	H	H	H	M	M						
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS701	BIG DATA ANALYTICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Data Structures, Data Ware Housing and Data Mining				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

The basics of Analytics – Concepts, Data preparation – merging, managing missing numbers sampling, Data visualization, Basic statistics.

UNIT- IINTRODUCTION TO BIG DATA 9

Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big Data Analytics - Big data characteristics - Volume, Veracity, Velocity, Variety – Data Appliance and Integration tools – Greenplum – Informatica.

UNIT- II DATA ANALYSIS 9

Evolution of analytic scalability – Convergence – parallel processing systems – Cloud computing –grid computing – map reduce – enterprise analytic sand box – analytic data sets – Analytic Methods –analytic tools – Cognos – Micro strategy - Pentaho. Analysis approaches – Statistical significance –business approaches – Analytic innovation – Traditional approaches – Iterative.

UNIT- III STREAM COMPUTING 9

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real time Analytics Platform(RTAP)applications IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis– Intelligent scheduler – Infosphere Streams.

UNIT- IV PREDICTIVE ANALYTICS AND VISUALIZATION 9

Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models –Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry -Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques –Hierarchical – K- Means – Clustering high dimensional data Visualizations - Visual data analysistechniques, interaction techniques; Systems and applications.

UNIT- V FRAMEWORKS AND APPLICATIONS 9

IBM for Big Data – Map Reduce Framework - Hadoop – Hive - – Sharding – NoSQL Databases - S3 -Hadoop Distributed file systems – Hbase – Impala – Analyzing big data with twitter – Big data for Ecommerce– Big data for blogs.

TEXT BOOKS:

1. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS BusinessSeries, 2012.
2. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”,Elsevier, 2007
3. Michael Berthold, David J. Hand,” Intelligent Data Analysis”, Springer, 2007.

REFERENCES:

1. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge UniversityPress, 2012.

2.**http://www.mosaic.geo-strategies.com/wp-content/uploads/2013/10/Big-Data-for-Dummies.pdf**

COURSE OUTCOMES (COs)	
CO1	Be able to understand Data Appliance and Integration tools like Greenplum and Informatica.
CO2	Have an awareness of the computational theory underlying NN.
CO3	Have a working knowledge of a typical neural network simulation
CO4	Experience in programming Predictive analysis and Visualization.
CO5	Have knowledge of sufficient in Hadoop and Map reduce concepts.
CO6	To understand Map Reduce Framework and Hadoop.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H	M			M			M
CO2	H	H	H	H	H	M			M			M
CO3	H	H	H	H	H	M			M			M
CO4	H	H	H	H	H	M			M			M
CO5	H	H	H	H	H	M			M			M
CO6	H	H	H	H	H	M			M			M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCCS7L1	**BIG DATA ANALYTICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	3	1.5
	Prerequisite – Data Structures &Data Mining				
	Lab Manual Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES
This laboratory course is intended to make the students know about Big Data Concepts.

LIST OF EXPERIMENTS

1. Summary statistics some sense of the data using R tool.
2. Calculate Hypothesis testing for sample dataset using R tool.
3. Visualization of Health care data using Greenplum.
4. Find the K-means clustering for given dataset.
5. Find the missing dataset using hadoop and map reduce.
6. Calculate mean, median, mode for the given dataset using R tool.
7. Classification using Naïve bayes approach.
8. The k-Nearest Neighbor Algorithm Using MapReduce Paradigm.

COURSE OUTCOMES (COs)	
CO1	Identify the need for big data analytics for a domain.
CO2	To Use Hadoop, Map Reduce Framework.
CO3	To Apply big data analytics for a give problem.

CO4	Suggest areas to apply big data to increase business outcome.
CO5	Contextually integrate and correlate large amounts of information automatically to gain faster insights
CO6	To apply K-Nearest Alogrithm for Big data application

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H	M			M			M
CO2	H	H	H	H	H	M			M			M
CO3	H	H	H	H	H	M			M			M
CO4	H	H	H	H	H	M			M			M
CO5	H	H	H	H	H	M			M			M
CO6	H	H	H	H	H	M			M			M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

PROGRAMME ELECTIVE-I

U18PECS011	**NATURAL LANGUAGE PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Principles of Compiler Design				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	This course is designed to introduce some of the problems and solutions of NLP, and their relation to linguistics and statistics.				

UNIT I INTRODUCTION 9

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues - Applications- The role of machine learning - Probability Basics –Information theory – Collocations -N-gram Language Models - Estimating parameters and smoothing - Evaluating language models.

UNIT IIMORPHOLOGY AND PART OF SPEECH TAGGING 9

Linguistic essentials - Lexical syntax- Morphology and Finite State Transducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models – Transformation based Models - Maximum Entropy Models. Conditional Random Fields.

UNIT III SYNTAX PARSING 9

Syntax Parsing - Grammar formalisms and tree banks - Parsing with Context Free Grammars- Features and Unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs.

UNIT IV SEMANTIC ANALYSIS 9

Representing Meaning – Semantic Analysis - Lexical semantics –Word-sense disambiguation - Supervised – Dictionary based and Unsupervised Approaches - Compositional semantics- Semantic Role Labeling and Semantic Parsing – Discourse Analysis.

UNIT V APPLICATIONS 9

Named entity recognition and relation extraction- IE using sequence labeling-Machine Translation (MT) - Basic issues in MT-Statistical translation-word alignment- phrase-based

translation – Question Answering.

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin Speech and Language Processing (2nd Edition),

U18PECS012	NETWORK INFORMATION SECURITY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Data structures and Algorithms				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	• To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning • To learn the new approaches in machine learning • To design appropriate machine learning algorithms for problem solving				

Prentice Hall; 2 edition, 2008.

2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and HinrichSchuetze, MIT Press, 1999.
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009.
4. Roland R. Hausser, Foundations of Computational Linguistics: Human-Computer Communication in Natural Language, Paperback, MIT Press, 2011.

REFERENCES:

1. Pierre M. Nugues, An Introduction to Language Processing with Perl and Prolog: An Outline of Theories, Implementation, and Application with Special Consideration of English, French, and German (Cognitive Technologies) Soft cover reprint, 2010.
2. James Allen, Natural Language Understanding, Addison Wesley; 2nd edition
3. NLTK – Natural Language Tool Kit - http://www.nltk.org

UNIT I INTRODUCTION **9**

History, What is Information Security?, Critical Characteristics of Information, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II SECURITY INVESTIGATION **9**

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT III SECURITY ANALYSIS **9**

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms, Information Flow and Confinement Problem

UNIT IV LOGICAL DESIGN **9**

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT V PHYSICAL DESIGN 9

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control

Devices, Physical Security, Security and Personnel

TOTAL 45 PERIODS

TEXT BOOK:

1. Michael E Whitman and Herbert J Mattord, ―Principles of Information Security‖, Vikas Publishing House, New Delhi, 2003
2.

REFERENCES:

1. Micki Krause, Harold F. Tipton, ― Handbook of Information Security Management‖, Vol 1-3 CRCPress LLC, 2004. 2. Stuart McClure, Joel Scrambray, George Kurtz, ―Hacking Exposed‖, Tata McGrawHill, 2003 3. Matt Bishop, ―Computer Security Art and Science‖, Pearson/PHI, 2002.

COURSE OUTCOMES (COs)	
CO1	To Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
CO2	To Apply principles of Data Science to the analysis of business problems
CO3	To Use data mining software to solve real-world problems.
CO4	To Employ cutting edge tools and technologies to analyze Big Data.
CO5	To Demonstrate use of team work, leadership skills, decision making and organization theory.
CO6	To Understand Learning Sets of Rules and Sequential Covering Algorithm

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H	H			H			M
CO2	H	H	H	H	H	H			H			M
CO3	H	H	H	H	H	H			H			M
CO4	H	H	H	H	H	H			H			M
CO5	H	H	H	H	H	H			H			M
CO6	H	H	H	H	H	H			H			M
Category	Programme Elective (PE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS013	**DATA WAREHOUSING AND DATA MINING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Data Base Management System				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

- Dramatic advances in data capture, processing power, data transmission, and storage capabilities are enabling organizations to integrate their various databases into data warehouses.
- Data mining is primarily used by the companies with a strong consumer focus. It enables these companies to determine the factors such as price, product positioning, or staff skills, and economic indicators, competition, and customer demographics.

UNIT- I DATAWAREHOUSE 9

Data Warehouse Roles and Structures – What is a Data Warehouse? – Multi Dimensional Data Model- Data Stores, Warehouses and Marts - The Data Warehouse Environment – Data Warehouse Characteristics - The Data Warehouse Architecture – Meta Data, Metadata Extraction - Implementing the Data Warehouse - OLAP Engine - Data Warehouse Backend Process – Data Warehouse Project Success Factors.

UNIT- II INTRODUCTION TO DATA MINING 9

Basic Data Mining Tasks, Data Mining versus Knowledge Discovery in Data Bases, Data Mining Issues, Data Mining Metrics. Social Implications of Data Mining.Data Mining from a Database Perspective. Data Mining Techniques - Introduction – A Statistical Perspective on Data Mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.

UNIT-III CLASSIFICATION 9

Introduction - Statistical Based Algorithms- Distance Based Algorithms – Decision Tree Based Algorithms - Neural Networks Based Algorithms – Rule Based Algorithms – Combining Techniques.

UNIT IV ASSOCIATION RULES 9

Introduction-Large Itemsets- - Methods to Discover Association Rules - Apriori Algorithm - Partition Algorithm. **Clustering Techniques**Introduction – Outliers – Clustering Paradigms – Hierarchical Algorithms, Partitional Algorithms - Clustering Large Databases.

UNIT-V WEB MINING 9

Introduction-Web Mining – Web Content Mining –Crawlers,Harvest System,Virtual Web View -Web Structure Mining –Page Rank, Web Usage Mining-Preprocessing, Data structures, Pattern Discovery and Pattern Analysis.

TEXT BOOKS

1. ArunK.Pujari.,"Data Mining Techniques", Universities Press,2013.
2. Margaret H. Dunham ,S.Sridhar, "Data Mining Introductory and Advanced Topics", Pearson Education,2006.
3. K.P.Soman,ShyamDiwakar,V.Ajay,"*Data Mining*: *Theory And Practice"* , PHI Learning Pvt. Ltd., 2006.

REFERENCE BOOKS

1. "Express Learning - Data Warehousing and Data Mining", ITL ESL,Pearson Education, 2012.
2. N.Venkatesan,S.Prabhu,"Data Mining and WareHousing", New Age International (P) Limited, 2010.
3. George M. Marakas, "Modern Data Warehousing, Mining and Visualization: Core concepts", Pearson Education,2003.
4.http://www.essi.upc.edu/~aabello/publications/11.IGIBook1.pdf

COURSE OUTCOMES (COs)	
CO1	Provide efficient distribution of information and easy access to data.
CO2	Create user friendly reporting environment.

CO3	Find the unseen pattern in large volume of historical data that helps to manage an organization efficiently.
CO4	Understand the concepts of various data mining Techniques.

U18PECS014	DIGITAL IMAGE PROCESSING	L	T	P	C
	• Total Contact Hours - 45	3	0	0	3
	• Prerequisite – Probability Statistics, Computer Graphics				
	• Course Designed by – Dept. of Computer Science & Engineering				

Mapping of COs with POs *(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low*

	Programme Outcomes(POs)											
COs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	M	H		H							H
CO2	M		H			M						H
CO3			H	M	H				H		H	H
CO4	M	M	H		H	M						H
CO5					H							M
CO6					M				M		H	H

OBJECTIVES

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

Category	Programme Elective(PE)
Approval	47th Academic Council Meeting held in Aug, 2018

CO5	Explain the Architecture of Data warehousing.
CO6	Understand the concept of Web Mining.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010.
2.Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
3. William K. Pratt, Digital Image Processing John Wiley, New York, 2002.

COURSE OUTCOMES (COs)	
CO1	Demonstrate the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement.
CO3	Implement the restoration concepts and filtering techniques.
CO4	Compare the basics of various segmentation and features extraction methods.
CO5	Design different coding and compression techniques
CO6	Design various edge and boundary detection for recognition and pattern matching.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3											
CO2	3		3									
CO3				3								
CO4	3			3								
CO5			3									
CO6			3		3							
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS015	**MULTICORE ARCHITECTURE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Computer Architecture and Organization, Artificial Intelligence				
	Course Designed by – Department of Computer Science & Engineering				

OBJECTIVES	To understand the need for multi-core processors, and their architecture. To understand the challenges in parallel and multi-threaded programming. To learn about the various parallel programming paradigms.

UNIT I MULTI-CORE PROCESSORS **9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES **9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP **9**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI **9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

UNIT V PARALLEL PROGRAM DEVELOPMENT **9**

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL HOURS **45**

TEXT BOOKS:

1. Peter S. Pacheco, ―An Introduction to Parallel Programming‖, Morgan-Kauffman/Elsevier, 2011.

2. Darryl Gove, ―Multicore Application Programming for Windows, Linux, and Oracle Solaris‖, Pearson, 2011 (unit 2)

REFERENCES

1. Michael J Quinn, ―Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill,2003.

2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.

3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

COURSE OUTCOMES (COs)

CO1	Describe multicore architectures and identify their characteristics and challenges.
CO2	Identify the issues in programming Parallel Processors.
CO3	Write programs using OpenMP and MPI.
CO4	Design parallel programming solutions to common problems.
CO5	Compare and contrast programming for serial processors and programming for parallel processors.
CO6	Develop multicore programs and design parallel solutions.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	M	L		L							
CO2	L	M	M									
CO3	M	M	M	L								
CO4	L	M	L									
CO5	L	L	L		L							
CO6	M	M	M									
Category	Programme Elective (PE)											
Approval												

U18PECS016	**SERVICE ORIENTED ARCHITECTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Big Data, Data Mining. Data Analytics				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To learn the concepts of distributed application development
- To differentiate XML based web services from other standard models
- To study the importance of service composition

UNIT I SOA FUNDAMENTALS **9**

SOA – Services – Loose Coupling – The Enterprise service bus – Service Classification – Business process management – SOA and the organization – SOA and the organization - SOA in context – Message exchange patterns – SOA life cycle – Versioning – Web services

UNIT II SERVICE-ORIENTED ANALYSIS AND DESIGN **9**

SOA Terminology and Concepts - REST Design Constraints and Goals - RESTful Service Orientation - Service Contracts with REST - Service-Orientation and REST Service-Oriented Analysis and Design with REST - Mainstream SOA Methodology - Analysis and Service Modeling with REST - Service-Oriented Design with REST HTML - Cookies - Simple PHP scripts

UNIT III SERVICE COMPOSITION **9**

Service Composition with REST - Fundamental Service Composition with REST – Advanced

Service Composition with REST - Service Composition with REST Case Study - Design Patterns for SOA with REST - Service Versioning with REST - Uniform Contract Profiles.

UNIT IV RESTFUL SERVICES AND THE RESOURCE-ORIENTEDARCHITECTURE 9

Introducing the Simple Storage Service - Object-Oriented Design of S3 - URIs - Addressability -Statelessness - Representations - Links and Connectedness - The Uniform Interface – Resource Design - Turning Requirements into Read-Only Resources - Service Implementation - Web service case studies - Connect Resources to Each Other - Controller Code - Model Code

UNIT V SOA TRANSACTION AND SECURITY 9

SOA and performance - SOA and security – Service Management - Model driven service deployment – Establishing SOA and SOA governance

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nicolai M.Josuttis, SOA in design - The art of distributed system design, O'REILLY publication, 2007.
2. Raj Balasubramanian, Benjamin Carlyle, Thomas Erl, Cesare Pautasso, "SOA with REST - Principles, Patterns & Constraints for building Enterprise solutions with REST", Prentice Hall/PearsonPTR , 2012.
3. Leonard Richardson and Sam Ruby, RESTful Web Services, O'REILLY publication, 2007.

REFERENCE:

1. Thomas Erl, ―Service Oriented Architecture: Concepts, Technology, and Design‖, Pearson education,2005.

COURSE OUTCOMES

CO1	Explain the fundamental principles of SOA.
CO2	Organise the services to perform the service composition.
CO3	Model and design a service-oriented system using architectural principles, development methods with SOA and related technologies to solve the real life problem
CO4	Outline the technologies used for SOA implementation.
CO5	Demonstrate software development using SOA as a team.
CO6	Understand the fundamentals of service oriented architecture design

CO/PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M											
2		S										
3	S											
4		M										
5	S											
6		M										

PROGRAMME ELECTIVE-II

U18PECS021	**NEURAL NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3

	Prerequisite – Artificial Intelligence, Data mining
	Course Designed by – Department of Computer Science & Engineering
OBJECTIVES	Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.

UNIT – I INTRODUCTION TO NEURAL NETWORKS
Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT – II ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS
Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN –Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement),Learning Rules.

UNIT – III SINGLE LAYER FEED FORWARD NETWORKS
Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.

UNIT – IV MULTI- LAYER FEED FORWARD NETWORKS
Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Back propagation Algorithm, Learning Difficulties and Improvements.

UNIT - V ASSOCIATIVE MEMORIES
Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory(BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function.

REFERENCES

1. Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education,2004.
2. Simon Haykin, "Neural Networks- A comprehensive foundation", PearsonEducation, 2003.
3. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networksusing MATLAB 6.0", TATA Mc Graw Hill, 2006.
4. S. Rajasekharan and G. A. Vijayalakshmi pai, "Neural Networks, Fuzzy logic,Genetic algorithms: synthesis and applications", PHI Publication, 2004.
5. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2000

COURSE OUTCOMES (COs)	
CO1	To understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
CO2	To describe the concepts of feed forward neural networks
CO3	To apply Artificial Neural Network to handle uncertainty and solve engineering problems.
CO4	To analyze the limitation of Single layer Perceptron
CO5	To build a knowledge of sufficient theoretical background to be able to reason about the behavior of neural networks.
CO6	To develop Delta learning rule of the output layer

Mapping of Course Outcomes with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H					H					
	CO2	H				M	M					
	CO3	H	H				H					
	CO4		H		H							
	CO5	M		H	H							
	CO6	H		H								
3	Category	Program Elective (PE)										

U18PECS022	SOFTWARE AND APPLICATION SECURITY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Computer Networks				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	• Describe today's increasing network security threats and explain the need to implement a comprehensive security policy to mitigate the threats. • Explain general methods to mitigate common security threats to network devices, hosts, and applications.				

UNIT-I INTRODUCTION **9**

Basic concepts-threats to software security, software vulnerabilities, controls; risk; confidentiality, integrity-availability; security policies, security mechanisms; assurance; prevention-detection, benefits of detecting software security, deterrence.

UNIT-II CRYPTOGRAPHY AND PROGRAM SECURITY **9**

Basic cryptography - Basic cryptographic terms- Historical background- Symmetric crypto primitives- Modes of operation- Cryptographic hash functions- Asymmetric crypto primitives- Program security.

UNIT-III MALICIOUS ATTACKS **9**

Malicious code: viruses, Trojan horses, worms- Program flaws: buffer overflows, time-of-check to time-of-use flaws-incomplete mediation- Defenses- Software development controls- Testing techniques.

UNIT-IV

SECURITY IN CONVENTIONAL OPERATING SYSTEMS **9**

Memory, time, file, object protection requirements and techniques- Protection in contemporary operating systems- Identification and authentication- Identification goals- Authentication requirements-Human authentication- Machine authentication.

TRUSTED OPERATING SYSTEMS

Assurance; trust- Design principles- Evaluation criteria- Evaluation process- Database management-Systems security - Database integrity- Database secrecy- Inference control- Multilevel databases.

UNIT-V APPLICATION SECURITY

Host-Based Intrusion Detection Systems (HIDS), Advantages and Disadvantages of HIDS. Host-Based Firewalls, Application Whitelisting, Endpoint Encryption,

TEXT BOOKS:

1.The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities, John McDonald , Mark Down , Justin Schuh,2006.
2. William Stallings, "Cryptography And Network Security Principles and Practices", Prentice Hall of India, 3rd Edition, 2003.

COURSE OUTCOMES (COs)	
CO1	To identify software security threats and determines efforts to counter them.
CO2	To Execute code for relevant cryptographic algorithms.
CO3	To analyzea secure access client for access to a server.
CO4	Understand Security in Conventional and Trusted Operating System.
CO5	To validate the intrusion Detection systems and Firewall
CO6	To classify and evaluate the Malicious attacks

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M – Medium, L-Low**

COs	**Programme Outcomes(POs)**												
	a	b	c	d	e	f	g	h	i	j	k	l	
CO1	M	M		M									
CO2	M	M		H	H								
CO3	H	H											
CO4	H												
CO5	H	H											
CO6	M	M											

MACHINE LEARNING

U18PECS023	**L**	**T**	**P**	**C**
Total Contact Periods – 45	3	0	0	3

Prerequisite – Data structures and Algorithms

Course Designed by – Department of Computer Science & Engineering

OBJECTIVES

- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn the new approaches in machine learning
- To design appropriate machine learning algorithms for problem solving

UNIT I INTRODUCTION 9

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING 9

K- Nearest Neighbor Learning – Locally weighted Regression – Radial Bases Functions –

Case Based Learning.

UNIT V ADVANCED LEARNING 9

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

TEXT BOOK:

1. Tom M. Mitchell, ―Machine Learning‖, McGraw-Hill Education (India) Private Limited, 2013.

REFERENCES:

1. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning)‖, The MIT Press 2004.
2. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective‖, CRC Press, 2009.

COURSE OUTCOMES (COs)	
CO1	To Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
CO2	To Apply principles of Data Science to the analysis of business problems
CO3	To Use data mining software to solve real-world problems.
CO4	To Employ cutting edge tools and technologies to analyze Big Data.
CO5	To Demonstrate use of team work, leadership skills, decision making and organization theory.
CO6	To Understand Learning Sets of Rules and Sequential Covering Algorithm

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H	H			H			M
CO2	H	H	H	H	H	H			H			M
CO3	H	H	H	H	H	H			H			M
CO4	H	H	H	H	H	H			H			M
CO5	H	H	H	H	H	H			H			M
CO6	H	H	H	H	H	H			H			M
Category	Programme Elective (PE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS024	**Pattern Recognition and Soft Computing**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	3	0	0	3
	Prerequisite –Digital signal or image Processing				
	Course Designed by – Computer Science and Engineering				
OBJECTIVES: To Provide a sound knowledge in recognition of patterns using pattern models and soft computing					

UNIT I 9

INTRODUCTION Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis.

UNIT II **9**

STATISTICAL PATTERN RECOGNITION

Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.**MODELS** Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models. **NON PARAMETRIC TECHNIQUES** Nonparametric Techniques: Density Estimation – Parzen Windows – K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification.

UNIT III **9**

CLUSTERING TECHNIQUES Unsupervised Learning and Clustering: Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation.

UNIT IV **9**

FUZZY SYSTEMS Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions- Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems –Fuzzy Decision Making - Fuzzy Tool box in Matlab. **GENETIC ALGORITHMS** Evolutionary Computation – Genetic Algorithms – Terminologies and Operators of GA –Ant Colony Optimization – Particle Swarm Optimization – GA Tool using MATLAB.

UNIT V **9**

Fuzzy Classification – Fuzzy Pattern Recognition – Applications of Neural Networks: Bio informatics, Knowledge Extraction, Security Systems, Natural Landmark Recognition Task - Applications of Genetic Algorithm: Machine Learning, Image Processing, Data Mining and Wireless Networks.

Text Book

1. Bishop, Christopher M., "Pattern Recognition and Machine Learning", First Edition, Springer, 2009.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", First Edition, Prentice-Hall of India, 2003.

Reference Books

1. S. Theodoridis, K. Koutroumbas, "Pattern Recognition", Fourth Edition, Academic Press, 2009.
2. Keinosuke Fukunaga, "Introduction to Statistical Pattern Recognition", Second Edition, Academic Press, 2003.
3. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley, 2010.
4. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", First Edition, Springer, 2007.

Course Outcome

	CO
CO 1	To apply the mathematical foundations for recognition of patterns.
CO 2	To Identify the pattern Recognition models.
CO 3	To apply the non-parametric techniques and clustering techniques in pattern Recognition in real time applications.
CO 4	To Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

CO 5	To Apply genetic algorithms to combinatorial optimization problems.

U18PECS025	**HIGH PERFORMANCE COMPUTER ARCHITECTURES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Computer Architectures				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters and to learn the different multiprocessor issues. To understand the design of the memory hierarchy.				

CO 6	To Effectively use of existing software tools to solve real problems using a soft computing approach

CO and PO mapping

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1 1	PSO2 2	PSO3 3
CO1	M	M													
CO2	H														
CO3	H	M	H												
CO4	H	H													
CO5	M														
CO6	M			M	M										

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computersArchitectures- Physical Infrastructure and Costs- Cloud Computing –Case Study-Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing

Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

REFERENCES:

1. Darryl Gove, ―Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011.
2. David B. Kirk, Wen-mei W. Hwu, ―Programming Massively Parallel Processors‖, Morgan Kauffman, 2010
3. David E. Culler, Jaswinder Pal Singh, ―Parallel computing architecture: A hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999
4. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.WeiXu, ―Scalable Parallel Computing‖, Tata McGraw Hill, NewDelhi, 2003.

COURSE OUTCOMES (COs)	
CO1	Identify the limitations of ILP.
CO2	Discuss the issues related to multiprocessing and suggest solutions
CO3	Point out the salient features of different multicore architectures and how they exploit parallelism.
CO4	Discuss the various techniques used for optimising the cache performance
CO5	Design hierarchal memory system
CO6	Point out how data level parallelism is exploited in architectures
Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)	

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**														
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	
2	CO1	M					M							
	CO2	M					M							
	CO3	M					M							
	CO4	M					M							
	CO5	M					M							
	CO6	M					M							

UNIT I PROJECTEVALUATION AND PROJECT PLANNING
Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION
Software process and Process Models – Choice of Process models - mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II A Parametric Productivity Model - Staffing Pattern.

UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT
Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

UNIT IV PROJECT MANAGEMENT AND CONTROL
Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

UNIT V STAFFING IN SOFTWARE PROJECTS
Managing people – Organizational behaviour – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications

U18PECS026	**SOFTWARE PROCESS AND PROJECT MANAGEMENT**	**L**	**T**	**P**	**C**
	• Total Contact Hours - 45	3	0	0	3
	• Prerequisite –Organizational Behaviour, Software Engineering				
	• Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

At the end of the course, the student shall be able to:

- To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project.
- To compare and differentiate organization structures and project structures.
- To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools.

genres – Communication plans.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCES:

1. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication,2011.
2. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.

COURSE OUTCOMES (COs)	
CO1	Explain software development life cycle
CO2	Analyse, prioritize, and manage requirements
CO3	Estimate the efforts required for software development
CO4	Define new processes based on the needs
CO5	Perform various tests to ensure quality
CO6	Identify and prioritize risks and create mitigation plans

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	a	b	c	D	E	F	G	h	i	j	k	l
CO1	M	H	H	H	M	L	M		M	H	M	H
CO2	M	H	H	H	M	M					M	M
CO3	M	H	H	H	M	M					M	M
CO4	M	H	H	H	M	M					M	M
CO5	M	H	H	H	M	M					M	M
CO6	M	H	H	H	M	M					M	M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

PROGRAMME ELECTIVE-III

U18PECS031	**CASE BASED REASONING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Artificial Intelligence ,Expert Systems				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To learn and understand the basic elements of case based reasoning. To understand the case retrieval. To learncomplex knowledge sources and knowledge management.				

UNIT I BASIC CASE BASED REASONING ELEMENTS 8

Case-Based Reasoning- Experiences and Cases -Parts of a Case -Problems - Solution Types - Case Representations - Case Bases - Similarity and Retrieval -Reuse and Adaptation - Models of CBR.

UNIT II CASE REPRESENTATION AND SIMILARITY MEASURES 9

Representation Layers - Completeness and Efficiency -Flat Attribute-Value Representation- Complex Representations in General. Similarity and Case Representations -Types of Similarity Measures -The Local-Global Principle for Similarity Measures - Virtual Attributes- Similarity Measure to Use. Complex Similarities: Graph Representations and Graph Similarities- Largest Common Subgraphs- Taxonomic Similarities- Similarities for Object-Oriented Representations- Many-Valued Attributes- Similarity for Processes and Workflows.

UNIT III CASE RETRIEVAL AND INDEXING 10

The Retrieval Task - Retrieval Errors-Basic Retrieval Methods: Query Generation-Filtering-Sequential Retrieval -Two-Level Retrieval -Geometric Methods - Voronoi Diagrams and k-Nearest Neighbours -Geometric Approximation - Geometric Filtering-Index-Based Retrieval - kd-Trees- Integration with Decision Trees. Case Indexing- Traditional Indexing Method-Case Indexing Using a Bayesian Model, Prototype-Based Neural Network and Three-Layered Back Propagation Neural Network.

UNIT IV CASE ADAPTATION AND CASE-BASE DEVELOPMENT 10

Rules - Adaptation Types -The Adaptation Process - Adaptation Using Several Cases - Adaptations Using the Solution Process - Quality Issues - Knowledge in the Adaptation Container. Case Based Development-Problem Formulation -Finding and Getting Data, Preprocessing - Case Acquisition- Prototypes and Evaluation The Knowledge Containers - Systematic Development of CBR Systems- Implementation Aspects -Combining CBR with Other Techniques-Maintenance.

UNIT V
COMPLEX KNOWLEDGE SOURCES AND KNOWLEDGE MANAGEMENT 8

Textual CBR- Images- Sensor Data and Speech - Conversational CBR.Knowledge Management- Case-Based Reasoning and Knowledge Management- CBR Implementing KM Cycles.

TEXT BOOKS:

1. Michael M. Richter and Rosina O. Weber, Case-based reasoning: a textbook, springer,2013.

2. S. Simon, P. Sankar, ―Foundations of Soft Case-Based Reasoning, 1st ed. Wiley-Interscience, 2004.

REFERENCES

1.J. Kolodner, ―Case-Based Reasoning, San Mateo, CA: Morgan Kaufmann Publishers;1993

2. I.Watson, Applying Case-Based Reasoning: Techniques for Enterprise Systems. San Francisco, CA: Morgan Kaufmann Inc.1997

COURSE OUTCOMES (COs)	
CO1	To illustrate Knowledge the basic elements of case based reasoning, case representation and similarity measures, the Case adapation with systematic development of CBR Systems
CO2	To Understand the Case Indexing and adaptation process for developing case based reasoning systems.
CO3	To Discover the Systematic development Systems, case based reasoning for managing complex knowledge sources.
CO4	To Illustrate and maintain the CBR with other technique and to find the similarities of Object Oriented Representations.
CO5	To Evaluate the Geometric Approximation, Graph Representation and Similarities.
CO6	To Create prototype-Based Neural Network and Three-Layered Back Propagation Neural Network, Textual CBR and Implementing KM Cycles.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H				H			M
CO2	H	H	H	H	H				H			M
CO3	H	H	H	H	H				H			M
CO4	H	H	H	H	H				H			M
CO5	H	H	H	H	H				H			M
CO6	H	H	H	H	H				H			M

U18PECS032	**CYBER FORENSICS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To learn computer forensics To become familiar with forensics tools				

UNIT I INTRODUCTION TO COMPUTER FORENSICS 9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II EVIDENCE COLLECTION AND FORENSICS TOOLS 9

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III ANALYSIS AND VALIDATION 9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV ETHICAL HACKING **9**

Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNIT V ETHICAL HACKING IN WEB **9**

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

TOTAL HOURS **45**

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2. CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.

REFERENCES

1. John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2. MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3. AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
4. Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group–2008.

COURSE OUTCOMES (COs)	
CO1	Understand the basics of computer forensics
CO2	Apply a number of different computer forensic tools to a given scenario
CO3	Analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure
CO5	Implement real-world hacking techniques to test system security
CO6	analyze the forensics data

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	M	M									
CO2	M	M	L					L				

CO3	L	M	H					M				
CO4	M	H	H									
CO5	L	L	M					M				
CO6	L	L	M					M				
Category	Programme Elective (PE)											
Approval												

U18PECS033	**DATA ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	0	0	3
	Prerequisite – Data Mining and Warehousing, Big Data,				
	Course Designed by Department of Computer Science and Engineering				
OBJECTIVES	The Student should be exposed to learn the different ways of Data Analysis and data streams to evaluate the mining, clustering and visualization concepts.				

UNIT I : INTRODUCTION TO BIG DATA 9

Introduction to Big Data Platform – Challenges of conventional systems – Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting – Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT II : DATA ANALYSIS 9

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction – Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT III : MINING DATA STREAMS 9

Introduction to Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Realtime Analytics Platform(RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

UNIT IV : FREQUENT ITEMSETS AND CLUSTERING 9

Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT V : FRAMEWORKS AND VISUALIZATION 9

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed

file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCES:

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics, John Wiley & sons, 2012.

2. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O‟Reilly, 2011.

3. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

Course Outcomes (COs)	
CO1	To remember the statistical analysis methods and modern analytic tools.
CO2	To understand the ability to solve neural networks and fuzzy logic concepts.
CO3	Apply Data stream mining to design real time analytic applications
CO4	Analyze the Clustering Concepts for various streaming algorithms.
CO5	Evaluate the Visualisation techniques and Hadoop file systems.
CO6	To create frameworks for itemsets and data streams to examine the Hadoop and clustering data.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
	CO1	H	H	H	H		M						M
	CO2	H	M		L	L							M
	CO3	M	M	L	M		L						
	CO4	H	H	M	L								L
	CO5	M		H	M	M							L
	CO6	H			H								M

U18PECS034	**AUGMENTED REALITY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Data Structure				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	This course provides students with an opportunity to explore the research issues in Augmented Reality (AR). It also makes the students know the basic concept and framework of augmented reality.				

UNIT 1: Introduction of Augmented Reality and Virtual Reality: 9

Fundamental Concept and Components of Augmented Reality. Primary Features and Present Development on Augmented Reality.

UNIT 2: Multiple Models of Input and Output Interface in Virtual Reality: **9**

Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

UNIT 3: Augmented and Mixed Reality: 9

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT 4: Visual Computation in Augmented Reality: 9

Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

UNIT 5: Application of AR in Digital Entertainment: **9**

AR Technology in Film & TV Production. AR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by AR.

TEXTBOOK

1) Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2) Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

REFERENCE BOOK

1) Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

COURSE OUTCOMES (COs)	
CO1	To understand Augmented reality and Virtual Reality
CO2	To gain knowledge about the different models in Virtual Reality
CO3	Understand the Mixed reality and compare with AR and VR
CO4	Apply the knowledge of AR in Computer Graphics and Real time environments
CO5	Apply the concepts of AR and VR in the real world applications
CO6	Master the core concepts of Augmented and Virtual reality

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	
2	CO1	M		M		M								
	CO2	M		M	H	M								
	CO3	M		M	H	M								
	CO4	M		M		M								
	CO5	M		M		M								

	CO6	M		M	H	M								

U18PECS035	PARALLEL AND DISTRIBUTED COMPUTING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: – Computer Science Fundamentals				
	Course Designed by :Dept of computer science and Engineering				

OBJECTIVES

- Principles of distributed simulation and applications using multiprocessor systems.
- Synchronization and time management for distributed environments.
- High-level architecture for distributed simulation.

UNIT I INTRODUCTION TO DISCRETE EVENT STIMULATION 9

Introduction - Why simulation -Why parallel and distributed simulation -Analytic simulation vs virtual environment - Typical applications - Basic concepts: system attribute, state variables, event list, simulation time - Basic mechanisms: time advance, event scheduling, inherent parallelism - Modeling issues and logical processes - Data model, probability distributions, statistics collection

UNIT II PARALLEL PROCESSING OVERVIEW 9

Brief introduction to parallel processing – Overview of cluster computing with MPI– Underlying technologies - Concurrent simulation processes

UNI III CONSERVATIVE SYNCHRONIZATION ALGORITHM9

Synchronization problem - Deadlock avoidance using null messages - Lookahead and the simulation model - Deadlock detection and recovery - Synchronous execution - Barriers Synchronization, Transient Messages, Time Distance between Logical Processes - Performance Issues - Pros and cons of conservative mechanism

UNIT IV DISTRIBUTED TRANSACTION PROCESSING 9

Transactions – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering – Comparison – Flat and Nested Distributed Transactions – Atomic Commit Protocols – Concurrency Control in Distributed Transactions – Distributed Deadlocks – Transaction Recovery – Overview of Replication And Distributed Multimedia Systems.

UNIT V HYBRID PROTOCOLS, DISTRIBUTED COMPUTING STANDARDS 9

Moving time windows – Space time simulation - Breathing time buckets - Local time warp - Distributed virtual environment – High level architecture, HLA - Overview, Rules, Object Model, Run-Time Infrastructure, Communication Issues

.

TEXT BOOKS:

1. Ruchard, M.Fujitmoto,"Parallel and Distributed Simulation Systems 1st Edition", Wiley-Interscience (2000).
2. Brendan Burns," Designing Distributed Systems",'Reilly Media; 1st Edition (March 5, 2018)

REFERENCES:

1. Martin Kleppmann,"Designing Data-Intensive Applications", 'Reilly Media; 1st Edition (April 11, 2017).
2. Maarten Van steen, Andrew S Tanenbaum, "Distributed Systems", CreateSpace Independent Publishing Platform; 3.01 Edition (February 1, 2017).
3. Andrew S. Tanenbaum, Maartenvan Steen, Distributed Systems, "Principles and Pardigms", Pearson Education, 2002.

COURSE OUTCOMES (COs)	
CO1	Explain why distributed simulation is needed.
CO2	Understand the main differences between two synchronization methods
CO3	Describe how the conservative method works
CO4	Describe how the optimistic method works
CO5	Understand hybrid approaches for distributed simulation..
CO6	Describe the HLA standard overview for simulation.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	M	H		H								H
2	CO1		H	M	H		M				M		
	CO2	L	M		H				M				M
	CO3						L			M			
	CO4		M	H	M						H		
	CO5	M		M	H								H
	CO6	M	H		H								H

3	Category	Humanities & Social Studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship
						√			
4	Approval	47th Academic Council meeting held at August 2018							

U18PECS036	**SOFTWARE ARCHITECTURE DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Software Engineering				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

1. To introduce to the students the basic knowledge of software, software Development process and the concepts of software design principles.
2. To impart knowledge on the different architectural styles and architectural patterns for the software.

UNIT- I INTRODUCTION AND ARCHITECTURAL DRIVERS

SYLLABUS: Introduction – What is software architecture? – Standard Definitions – Architectural structures – Influence of software architecture on organization-both business

andtechnical – Architecture Business Cycle- Introduction – Functional requirements – Technical constraints – Quality Attributes.

UNIT II QUALITY ATTRIBUTE WORKSHOP

Quality Attribute Workshop – Documenting Quality Attributes – Six part scenarios – Case studies.

UNIT III ARCHITECTURAL VIEWS

Introduction – Standard Definitions for views – Structures and views - Representing views-available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies.

UNIT IV ARCHITECTURAL STYLES

Introduction – Data flow styles – Call-return styles – Shared Information styles - Event styles – Case studies for each style.

UNIT V DOCUMENTING THE ARCHITECTURE

SYLLABUS: Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages– Need for formal languages - Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures

TEXT BOOKS:

1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices", 2nd Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide", Auerbach Publications, 2010.

REFERENCES:

1. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison-Wesley, 2010.
2. Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Methods and case studies. Addison-Wesley, 2001.
3. RajkumarBuyya, James Broberg, and AndrzejGoscinski, "Cloud Computing. Principles andParadigms", John Wiley & Sons, 2011
4. Mark Hansen, "SOA Using Java Web Services", Prentice Hall, 2007
5. David Garlan, Bradley Schmerl, and Shang-Wen Cheng, "Software Architecture-Based Self- Adaptation," 31-56. Mieso K Denko, Laurence Tianruo Yang, and Yan Zang (eds.), "Autonomic Computing and Networking". Springer Verlag, 2009

COURSE OUTCOMES

COURSE OUTCOMES (COs)	
CO1	Ability to understand the software architectural requirements, drivers and to explain About the influence of software architecture on business and technical activities.
CO2	Able to analyze the quality attribute workshop and to apply the concept to prepare the documentation on quality attribute.
CO3	Ability to understand, identify the key architectural structures and to use the views to Specify architecture.
CO4	Ability to use & evaluate the styles to specify architecture.
CO5	Ability to design document for a given architecture.
CO6	To understand various software architectural design and testing concepts.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	L	M		M	H	M	H
CO2	M	H	H	H	M	M					M	M
CO3	M	H	H	H	M	M					M	M
CO4	M	H	H	H	M	M					M	M
CO5	M	H	H	H	M	M					M	M
CO6	M	H	H	H	M	M					M	M
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

PROGRAMME ELECTIVE-IV

U18PECS041	ADVANCED DEEP LEARNING AND COMPUTER VISION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Machine learning				
	Course Designed by :Dept of computer science and Engineering				

OBJECTIVES

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms inmachine learning
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To study some applications of computer vision algorithms.

UNIT I INTRODUCTION 9

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DIMENTIONALITY REDUCTION 9

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT –IIIIMAGE PROCESSING FOUNDATIONS 9

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical

morphology – texture.

UNIT- IV SHAPES AND REGIONS **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT –VAPPLICATIONS **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TEXTBOOKS:

1. L. Baggio et al., "Mastering Open CV with Practical Computer Vision Projects", Packet Publishing, 2012.
2. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.

REFERENCES:

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES (COs)	
CO1	To understand the need for machine learning for various problem solvin
CO2	Implement various deep learning models
CO3	To put back to a new high dimensional data using reduction techniques
CO4	Analyze optimization and Generalization in deep learning
CO5	To develop various neural networks & deep learning
CO6	Implement various deep learning models

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	M	H		H								H
2	CO1		H	M	H		M				M		
	CO2	L	M		H				M				M
	CO3						L			M			
	CO4		M	H	M						H		
	CO5	M		M	H								H
	CO6	M	H		H								H

3	Category	Humanities & Social Studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship

4	Approval	47th Academic Council meeting held at August 2018

U18PECS042	ETHICAL HACKING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

This course gives to explore the concepts of security testing and the knowledge required to protect against the hacker and attackers.

UNIT I INTRODUCTION TO HACKING

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks– Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – DNS Information Tools – Locating the Network Range

UNIT II SCANNING AND ENUMERATION

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools

UNIT III ARCHITECTURE

Architecture strategies for computer fraud prevention – Protection of Web sites – Intrusion detection system – NIDS, HIDS –Web Services– Reducing transaction risks

UNIT IV SYSTEM HACKING

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Countermeasures– Keyloggers and Spyware

UNIT V PENETRATION TESTING

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Penetration Testing Tools

REFERENCES

1.Jon Erickson, “Hacking, 2nd Edition: The Art of Exploitation”, No Starch Press Inc., 2008.

2. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, 2013.

3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Second Edition, Elsevier, 2013.

4. Kenneth C.Brancik “Insider Computer Fraud” Auerbach Publications Taylor & Francis Group– 2008.

COURSE OUTCOMES (COs)	
CO1	To understand various hacking techniques and attacks.
CO2	To evaluate where information networks are most vulnerable.

CO3	To identify methods to gain access to systems
CO4	To assess and measure threats to information assets.
CO5	To remember the importance of information security
CO6	To illustrate the different phases in penetration testing.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) **H-High, M – Medium, L-Low**

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M			M		M		H				
CO2	H	H		H	H	M		M				
CO3	H	M		M								
CO4	M	M		H	M	M						
CO5						H						
CO6				H								

U18PECS043	**WEB MINING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – DATA MINING				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To focus on a detailed overview of the data mining process and techniques, specifically those that are relevant to Web mining To Understand the basics of Information retrieval and Web search with special emphasis on web Crawling				

UNIT I INTRODUCTION

Introduction – Web Mining – Theoretical background –Algorithms and techniques – Association rule mining – Sequential Pattern Mining -Information retrieval and Web search – Information retrieval Models-Relevance Feedback- Text and Web page Pre-processing – Inverted Index – Latent Semantic Indexing – Web Search – Meta-Search – Web Spamming

UNIT II WEB CONTENT MINING

Web Content Mining – Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers. Unsupervised Learning - K-means Clustering - Hierarchical Clustering –Partially Supervised Learning – Markov Models - Probability-Based Clustering - Evaluating Classification and Clustering – Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction - Opinion Mining and Sentiment Analysis - Document Sentiment Classification

UNIT III WEB LINK MINING

Web Link Mining – Hyperlink based Ranking – Introduction -Social Networks Analysis- Co-Citation and Bibliographic Coupling - Page Rank -Authorities and Hubs -Link-Based Similarity Search - Enhanced Techniques for Page Ranking - Community Discovery – Web Crawling -A Basic Crawler Algorithm- Implementation Issues- Universal Crawlers- Focused Crawlers- Topical CrawlersEvaluation - Crawler Ethics and Conflicts - New Developments

UNIT IV STRUCTURED DATA EXTRACTION

Structured Data Extraction: Wrapper Generation – Preliminaries- Wrapper Induction- Instance-Based Wrapper Learning ·- Automatic Wrapper Generation: Problems - String Matching and Tree Matching -. Multiple Alignment - Building DOM Trees - Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching - Schema-Level Match - Domain and Instance-Level Matching – Extracting and Analyzing Web Social Networks.

UNIT V WEB USAGE MINING

Web Usage Mining - Click stream Analysis -Web Server Log Files - Data Collection and PreProcessing - Cleaning and Filtering- Data Modeling for Web Usage Mining - The BIRCH Clustering Algorithm -Affinity Analysis and the A Priori Algorithm – Binning. Discovery and Analysis of Web Usage Patterns – Modeling user interests –Probabilistic Latent Semantic Analysis – Latent Dirichlet Allocation Model– Applications- Collaborative Filtering-Recommender Systems – Web Recommender systems based on User and Item – PLSA and LDA Models

TEXT BOOKS:

1. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; 2nd Edition 2009
2. GuandongXu ,Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition.2010

REFERENCES:

1. Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2007
2. SoumenChakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann; edition 2002
3. Adam Schenker, "Graph-Theoretic Techniques for Web Content Mining", World Scientific Pub Co Inc , 2005
4. Min Song, Yi Fang and Brook Wu, Handbook of research on Text and Web mining technologies, IGI global, information Science Reference – imprint of :IGI publishing, 2008.

COURSE OUTCOMES:

CO1	Build a sample search engine using available open source tools
CO2	Identify the different components of a web page that can be used for mining
CO3	Apply machine learning concepts to web content mining
CO4	Implement Page Ranking algorithm and modify the algorithm for mining information
CO5	Design a system to harvest information available on the web to build recommender systems
CO6	Analyze social media data using appropriate data/web mining techniques

COs	**Programme Outcomes(POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3		3	3	2						
CO2		3			3		2			2	2	
CO3		3		3		2						
CO4			3				2	2				2
CO5		3			3							
CO6	3	3		3								

	INFORMATION VISUALIZATION	**L**	**T**	**P**	**C**

U18PECS044	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	This course provides students with an opportunity to core skills for visual analysis. It also makes the students to know the basic core skills for visual analysis.				

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT IV INFORMATION DASHBOARD 9

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT V INFORMATION DASHBOARD DESIGN 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

REFERENCES:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and JesperThorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

COURSE OUTCOMES (COs)	
CO1	To gain the knowledge about information visualization
CO2	Apply core skills for visual analysis
CO3	Apply visualization techniques for various data analysis tasks
CO4	Analysis the distribution, correlation and multivariate pattern and techniques
CO5	Understand the information regarding dashboard
CO6	Implement the Dashboard design concept in real world environment

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	H	M		M							
	CO2	M	H	M	H	M							
	CO3	M	H	M	H	M							
	CO4	M	H	M		M							
	CO5	M	H	M		M							
	CO6	M	H	M	H	M							

U18PECS045	NETWORKED APPLICATIONS AND SERVICES	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Computer Networks				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	This course provides students to understand the concept of network management standards and to analyze the concept of examples of network management.				

UNIT 1: FOUNDATIONS: 9

Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros–functional model. Network management application functional requirements:Configuration management– fault management–performance management–Error correlation technology– security management– accounting management– common management–report management– polity based management–service level management–management service–community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT 2: COMMON MANAGEMENT INFORMATION SERVICE ELEMENT 9

CMISE model–service definitions–errors–scooping and filtering features– synchronization– functional units– association services– common management information protocol specification.

UNIT 3: INFORMATION MODELING FOR TMN 9

Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management 24 information base.

UNIT 4: SIMPLE NETWORK MANAGEMENT PROTOCOL 9

SNMPv1: managed networks–SNMP models– organization model–information model– SNMPv2 communication model–functional model–major changes in SNMPv2–structure of

management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture– applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.

UNIT 5: NETWORK MANAGEMENT EXAMPLES 9

ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies– ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP

TEXT BOOKS:

1. Mani Subramanian, "Network Management: Principles and Practice" Pearson Education, Second edition, 2010
2. Lakshmi G Raman, "Fundamentals of Telecommunications Network Management" ,Wiley, 1999

REFERENCES:

1. Henry Haojin Wang, "Telecommunication Network Management", Mc- GrawHill ,1999
2. Salah Aidarous& Thomas Plevyak, "Telecommunication Network Management: Technologies and Implementations" , Wiley,1997.

COURSE OUTCOMES (COs)	
CO1	Design and analyze of fault management.
CO2	Analyze the common management information protocol specifications
CO3	Design and analyze of management information model.
CO4	Design the simple network management protocol.
CO5	Design the various types of network management tools
CO6	Apply the network management concept in the real world environment.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) **H-High, M-Medium, L-Low**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M		M		H							
	CO2	M		M		H							
	CO3	M		M		H							
	CO4	M		M		H							
	CO5	M		M		H							
	CO6	M		M	M	H							

U18PECS046	**SOFTWARE ANALYSIS AND TESTING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Software Engineering				
	Course Designed by – Department of Computer Science & Engineering				

OBJECTIVES	• Analyzing, Designing, Implementing and Testing programs using Object Oriented Technologies, in order to produce maintainable, high-quality, software applications. • Software quality attributes reliability, correctness, testability, maintainability, flexibility, portability, efficiency, integrity, usability, reusability, and interoperability.

UNIT I INTRODUCTION 9

Definition of Software- Types of software- Characteristics of Software- Attributes of good software- Software Engineering- Software engineering costs- Systems engineering & software Engineering- challenges facing software engineering, Rapid software development- Computer Aided Software Engineering- Agile methods.

UNIT II SYSTEM REQUIREMENTS 9

Requirements elicitation for medium-size applications-Requirements representation and analysis using flow-oriented and scenario-oriented notations-Architectural high-level design of software applications-Structural and behavioural design of software applications, using the Object Oriented paradigm.

UNIT III SOFTWARE DESIGN 9

Design concepts– Abstraction– Architecture– Patterns– Modularity– Cohesion– Coupling – Information hiding– Functional independence Refinement– Design of input and Control– Design of User Interface design – Design issues– Features of modern GUI - Menus, Scroll bars, windows ,Buttons, icons, panels, error Messages etc.

UNIT IV SOFTWARE TESTING 9

Introduction to testing design strategies – The smarter tester – Test case design strategies – Using black box approach to test case design – Random testing – Equivalence class partitioning – Boundary value analysis – Other black box test design approaches – Black box testing and COTS – Using white box approach to test design – Test adequacy criteria – Coverage and control flow graphs – Covering code logic – Paths – Their role in white box based test design – Additional white box test design approaches – Evaluating test adequacy criteria.

UNIT V LEVELS OF TESTING 9

The need for levels of testing – Unit test – Unit test planning – Designing the unit tests – The class as a testable unit – The test harness – Running the unit tests and recording results – Integration tests – Designing integration tests – Integration test planning – System test – The different types – Regression testing – Alpha, beta and acceptance tests.

TEXT BOOKS:

1. Software engineering a practitioner's approach, 7ªed. Roger Pressman. McGraw Hill Higher Education, 2010.

2. Paul C. Jorgensen, “Software Testing: A Craftsman's Approach”, Fourth Edition, 2013.

COURSE OUTCOMES (COs)	
CO1	To understand lifecycle models and Software Architecture.
CO2	To understand the principles involved in gathering and validating software requirements.
CO3	To analyze various software design architecture and Design pattterns .

CO4	To apply the Concepts and techniques for black-box and white-box testing.
CO5	To relationship between testing, software quality and other verification techniques.
CO6	To Understand different levels of testing.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H	H	H	M	M					M	M
CO2	M	H	H	H	M	M					M	M
CO3	M	H	H	H	M	M					M	M
CO4	M	H	H	H	M	M					M	M
CO5	M	H	H	H	M	M					M	M
CO6	M	H	H	H	M	M					M	M
Category	Programme Elective (PE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

PROGRAMME ELECTIVE-V

U18PECS051	**COGNITIVE MODELING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	PRE-REQUISITES: Artificial Intelligence, Expert System				
	Course Designed by – Dept. of Computer Science & Engineering				
OBJECTIVES	• To become familiar fundamentals of Cognitive science. • To get exposed to simple Inference rules and decision support system. • To design the applications				

UNIT – I INTRODUCTION TO COGNITIVE SCIENCE AND COGNITIVE COMPUTING WITH AI: 9

Cognitive Computing - Cognitive Psychology - The Architecture of the Mind - The Nature of Cognitive Psychology – Cognitive architecture – Cognitive processes – The Cognitive Modeling Paradigms - Declarative / Logic based Computational cognitive modeling – connectionist models – Bayesian models.

UNIT – II INTRODUCTION TO KNOWLEDGE-BASED AI AND FUZZY LOGIC 9

Introduction to Knowledge-Based AI – Human Cognition on AI – Cognitive Architectures, Fuzzy Grey cognitive maps – Dynamic Random fuzzy cognitive Maps

UNIT – III COGNITIVE COMPUTING WITH INFERENCE AND DECISION SUPPORT SYSTEMS 9

Intelligent Decision making - Fuzzy Cognitive Maps – Learning algorithms: Non-linear Hebbian Learning – Data driven NHL - Hybrid learning

UNIT – IV COGNITIVE COMPUTING WITH MACHINE LEARNING 9

Machine learning Techniques for cognitive decision making – Hypothesis Generation and Scoring - Natural Language Processing - Representing Knowledge - Taxonomies and

Ontologies - Deep Learning (11)

UNIT – V CASE STUDIES **9**

Cognitive Systems in health care – Cognitive Assistant for visually impaired – AI for cancer detection, Predictive Analytics - Text Analytics - Image Analytics -Speech Analytics – IBM Watson - Introduction to IBM's PowerAI Platform - Introduction to Google's TensorFlow Development Environment

TOTAL: 45 PERIODS

TEXTBOOK:

1. Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Wiley, Indianapolis, 2005.

2. Jerome R. Busemeyer, Peter D. Bruza, "Quantum Models of Cognition and Decision", Cambridge University Press, 2014.

REFERENCES:

1. Emmanuel M. Pothos, Andy J. Wills, "Formal Approaches in Categorization", Cambridge University Press, 2011.

2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.

3. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, "Cognitive Science: An Introduction", MIT Press, 1995.

COURSE OUTCOMES (COs)	
CO1	Demonstrate the basics and fundamentals of cognitive science and cognitive computing
CO2	Apply knowledge based artificial methods and fuzzy models.
CO3	Implement the cognitive computing in machine learning algorithms.
CO4	Compare the basics of various decision support systems.
CO5	Develop various applications using IBM's PowerAI and Google's TensorFlow Development Environment
CO6	Develop Predictive Analytics in Text, Image and Speech.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3											
CO2	3		3									
CO3				3								
CO4	3			3								
CO5			3									
CO6			3		3							
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS052	WEB SECURITY	L	T	P	C
	Total Contact Periods – 45	3	0	3	3
	Prerequisite – Computer Network				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	• To understand basics of Network Security and web security. • To be able to secure a message over insecure web channel by various means. • To learn about how to maintain the Confidentiality, Integrity and Availability of a web data. • To understand various protocols for web security to protect against the threats in the networks.				

UNIT I CRYPTOGRAPHY BASICS 9

Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Confusion and Diffusion, Data encryption standard, round function, modes of operation, cryptanalysis, brute force attack, Security Goals (Confidentiality, Integrity, Availability).

UNIT I ALGORITHMSIN CRYPTOGRAPHY 9

Public key Cryptography, Modulo arithmetic, Greatest common divisor, Euclidean algorithm, RSA algorithm, hash function, attack on collision resistance, Diffie-Hellman key exchange, Digital signature standard, elliptic curve cryptography

.UNIT III AUTHENTICATION TECHNIQUES 9

One way Authentication, password based, certificate based, Mutual Authentication ,shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP security overview:- security association & Encapsulating security payload ,tunnel and transfer modes, internet key exchange protocol, Secure Socket Layer(SSL), Transport Layer Security (TLS).

UNIT IV SOFTWARE VULNERABILITIES 9

Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks,IoTRansomewares, Email security:- Security services of E-mail ,Establishing keys, Privacy Authentication of the source, Message integrity ,Non-Repudiation, Viruses, Worms, Malware.

UNIT V WEB ISSUES 9

Introduction, Uniform Resource Locator/uniform resource identify, HTTP, Cookies, Web security problem, Penetration Testing, Firewalls:- functionality, Polices and Access Control, Packet filters, Application level gateway, Encrypted tunnel, Security architecture, Introduction to intrusion detection system.

TEXT BOOKS:

1. Bernard Menezes, " Network Security and Cryptography", CENGAGE Learning.
2. Charlie Kaufman, " Network Security", PHI.
3. Forouzan, "Cryptography & Network Security", TMH

REFERENCES:

1. Randy Weaver, " Network Infrastructure Security", Cengage Learning.
2. AtualKahate, " Cryptography and Network Security", TMH.

3. William Stalling, " Cryptography and Network security", Pearson.

COURSE OUTCOMES (COs)	
CO1	Should be able to identify network security threats and determine efforts to counter them.
CO2	Should be able to write code for relevant cryptographic algorithms.
CO3	Should be able to write a secure access client for access to a server.
CO4	Should be able to send and receive secure mails.
CO5	Should be able to determine firewall requirements, and configure a firewall.
CO6	To understand Penetration Testing, Firewalls andits functionality.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) **H-High, M – Medium, L-Low**												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	L	H	H	H	L	M					M	M
CO2	L	H	H	H	L	M					M	M
CO3	L	H	H	H	L	M					M	M
CO4	L	H	H	H	L	M					M	M
CO5	L	H	H	H	L	M					M	M
CO6	L	H	H	H	L	M					M	M
Category	Programme Elective (PE)											

U18PECS053	**DATA AND VISUAL ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Database Management System, Big data analytics				
	Course Designed by – Dept. of Computer Science and Engineering.				

OBJECTIVES

Develop in depth understanding of the key technologies in data analytics & Visualization: data mining, machine learning, visualization techniques, predictive modeling, and statistics.The basics of Analytics – Concepts, Data preparation, managing and analysis.

COURSE OUTCOMES (COs)	
CO1	Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
CO2	Apply principles of Data Science to the analysis of business problems
CO3	Use data mining software to solve real-world problems.
CO4	Employ cutting edge tools and technologies to analyze Big Data.
CO5	Demonstrate use of team work, leadership skills, decision making and organization theory.
CO6	Understand the need of data analytics and visualization techniques

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H		H							H
	CO2		M									M	
	CO3		M			H							H
	CO4	M					H					M	

	CO5			M		M							M
	CO6					H							M
3	Category	Humanities & Social Studies (HS)		Basic Sciences &Maths (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship
									√				
4	Approval	47th Academic Council meeting held at August 2018											

UNIT- I INTRODUCTION TO DATA RETRIEVAL 9

Data Models-Data Storage and Querying-Big data analytics building blocks- -Data collection –- Simple storage- Database SQL, data cleaning, normalization, feature selection- Best Practices for Data Analytics - Decompositions and dimensionality reductionSVD and CUR

UNITIIDATAPREPROCESSING&MINING 9

Data cleaning – Data scraping - Data preprocessing-cleaning and summarization-Predictive analysis-supervised learning-Classification –Classification key concepts, KNN- Cross Validation-Decision tree- Regression - unsupervised-Clustering- K-mean, hierarchical clustering Association – apiriori Algorithm

UNIT-III STATISTICAL DATA ANALYSIS 9

Exploratory Data Analysis-Statistics-Correlation- Introduction to the R data analysis environment-analytic data sets – Analytic Methods –analytic tools – Cognos – Micro strategy - Pentaho. Analysis approaches – Statistical significance –business approaches – Analytic innovation – Traditional approaches – Iterative-Real time Analytics Platform(RTAP)applications.

UNIT IV – GRAPHAND TEXT NALYTICS 9

Graph Analytics- Centrality – Page rank Algorithm - Random Walks with Restarts - graph clustering methods(MinFcut, Spectral, Clustering)-Memory-mapping/virtual memory to scale up algorithm – Interactive Applications- Evaluating Apps– Text analytics concepts and applications.

UNIT- V VISUALIZATION 9

Visualization I:Visualizing to explore-Exploration in scale: Introduction to map reduce.Clustering high dimensional data Visualizations - Visual data analysistechniques, interaction techniques; Systems and applications - visualizing inferences and uncertainty

TEXTBOOKS:

1. 1. Introduction to Data Science, with Introduction to R Jeffrey Stanton 2012.
2. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing, CRC Press, 2011.
3. **ArunK.Pujari.,"Data Mining Techniques", Universities Press,2013**
4. Storytelling with data –A data visualization guide for business professionals by Cole Nussbaumerknaflic

REFERENCES:

1.Wagner, S., Steinmetz, M., Bode, A., Müller, M.M. (Eds.),, High Performance Computing in Science and Engineering, Garching/Munich, Springer Verlog, 2010.
2. Abraham Silberschatz, Henry. F. Korth and S. Sudharshan, "Database System Concepts", 6th Edition, Tata McGraw Hill, 2011
3. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS BusinessSeries, 2012.
4.ColleenMccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis",Elsevier, 2007

https://ischool.syr.edu/media/documents/2012/3/DataScienceBook1_1.pdf

U18PECS054	DEEP LEARNING IN COMPUTER VISION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Computer Vision				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

This course covers the basics of machine learning, neural networks and deep learning. Model for deep learning technique and the various optimization and generalization mechanisms are included. Major topics in deep learning and dimensionality reduction techniques are covered.

- To present mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT I INTRODUCTION **9**

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DEEP NETWORKS **9**

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow NetworksConvolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT III DIMENTIONALITY REDUCTION **9**

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT IV OPTIMIZATION AND GENERALIZATION **9**

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic OptimizationGeneralization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint DetectionBioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions

TEXT BOOKS

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCE BOOKS

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES (COs)	
CO1	Understand the basics of deep learning concepts
CO2	Implement various deep learning models
CO3	To put back to a new high dimensional data using reduction techniques
CO4	Analyze optimization and Generalization in deep learning
CO5	To develop various neural networks & deep learning
CO6	To develop deep learning applications

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M		M		M				M			
CO2	M		M	H	M				M			
CO3	M		M	H	M				M			
CO4	M		M		M				M			
CO5	M		M		M				M			
CO6	M		M	H	M				M			

U18PECS055	**HIGH PERFORMANCE COMPUTING ARCHITECTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Cloud Computing, Grid Computing, Advanced Computer Architectu				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The objective of this course is to introduce the design and fundamental computer architectures in high performance computing massively parallel processing (MPP) systems.

UNIT – 1 PARALLEL PROCESSING AND PIPELINING PROCESSING 9

Overview of parallel processing and pipelining processing, study and comparison of uni-processors and parallel processors, conventional and Explicitly Parallel Instruction Computing (EPIC) Architecture; Evolution of parallel processors, future trends and their architecture. Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism.

UNIT – II SIMD and ARRAY PROCESSORS 9

Parallel computers-Taxonomy of parallel computing paradigms SIMD Computer Organization Masking and Data network mechanism, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network.

Parallel Algorithms for Array Processors: Models of computation, Analysis of parallel Algorithms, Matrix Multiplication. Sorting, SIMD computer organization; Implementation issues of Matrix multiplication and sorting on array processor and their analysis, Distributed memory programming with MPI, Shared memory programming with open MP

UNIT – III HIGH PERFORMANCE COMPUTING (HPC) PARADIGMS 9

Introduction, Mainframe solution using HPC, Cluster computing architecture, Advanced cluster computing systems, Difference between Grid and Cluster; Grid Computing, Evolution of Grid Computing, Intelligent mainframe grid architecture, Design principle and goals of a grid system, Grid system architecture, Grid systems and applications; OSGI framework. Symmetric Multiprocessing (SMP), SMP and Cluster methods, Thread model, NUMA machines.

UNIT – IV CLOUD COMPUTING AND VIRTUALIZATION TECHNOLOGY

Introduction to cloud computing, definition, architecture-characteristics, cloud computing platforms, SaaS, PaaS, IaaS., Google app engine, Amazon EC2, Sharing-scaling-and-elasticity patterns, Reliability-resiliency-and-recovery patterns, Cloud service and storage security patterns. Virtualization technology-virtual machine technology, virtual machines and elastic computing, Desktop virtualization and application. Virtual server and Hypervisor connectivity and management patterns, Parallel computing, Parallel efficiency of Map-Reduce.

UNIT – V

ADVANCED COMPUTING

Introduction to Petascale computing, Introduction to supercomputers, ARM processor, Superscalar pipelining, Quantum computing, HPC in remote sensing, Load balancing over networks, VLSI models.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture- Parallelism, Scalability, Programmability, McGraw-Hill Education, 2016

REFERENCE BOOKS:

1. V. Rajaraman and C. Siva Ram Murthy, Parallel Computers: Architecture and programming, PHI-India, 2005.
2. Pethuru Raj, Anupama Raman, Dhivya Nagaraj, and Siddhartha Duggirala, High-Performance Big-Data Analytics-Computing systems and approaches, Springer, 2015
3. Thomas Erl, Robert Cope and Amin Naserpour, Cloud Computing Design Patterns, Pearson Education, 2017.

4.

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	Understand high performance computing
CO2	Understand models in parallel and distributed computing
CO3	Evaluate design and concepts in advanced computer architecture
CO4	Analyze parallel processing systems – optimization and operation
CO5	Understand advanced computing technologies
CO6	Design advanced computing technologies

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3											
CO2	3		3									
CO3				3								
CO4	3			3								
CO5			3									
CO6			3		3							
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS056	**BUSINESS INTELLIGENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Software Engineering, Service Oriented Architectures				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The student should be made to:

- Be exposed with the basic rudiments of business intelligence system
- understand the modeling aspects behind Business Intelligence
- understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

UNIT I BUSINESS INTELLIGENCE **9**

Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.

UNIT II KNOWLEDGE DELIVERY **9**

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/ Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

UNIT III EFFICIENCY **9**

Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis

UNIT IV BUSINESS INTELLIGENCE APPLICATIONS **9**

Marketing models – Logistic and Production models – Case studies.

UNIT V FUTURE OF BUSINESS INTELLIGENCE **9**

Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BISearch & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013.

REFERENCES:

2. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle ofDecision Making", Addison Wesley, 2003.

3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", WileyPublications, 2009.

4. David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager's Guide", SecondEdition, 2012.

5. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw- Hill, 2007.

6. Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, "The Data Warehouse Lifecycle Toolkit", Wiley Publication Inc.,2007.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1	Explain the fundamentals of business intelligence.
CO2	Link data mining with business intelligence.
CO3	Apply various modeling techniques.
CO4	Explain the data analysis and knowledge delivery stages.
CO5	Apply business intelligence methods to various situations.
CO6	Decide on appropriate technique.

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	H	M										
2	M											
3	H											
4		M										
5	M		M									
6												

H-Strong, M-Medium, W-Weak

PROGRAMME ELECTIVE-VI

U18PECS061	AUGMENTED REALITY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Artificial Intelligence, Expert Systems				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	This course is designed to introduce some of the problems and solutions of Virtual Reality and Augmented Reality, and their applications.				

UNIT I INTRODUCTION 9

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & hapticfeedback.

UNIT II CONTENT CREATION CONSIDERATIONS FOR AR 9

Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.

UNIT III DEVELOPMENT PROCESS 9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT IV AR ON THE WEB &AR ONTHE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT V APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking- other applications- games, movies, simulations, therapy.

TEXT BOOKS:

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg& Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN:9780321883575
2. C.Burdea&PhilippeCoiffet,―VirtualRealityTechnology‖,SecondEdition,Gregory,John Wiley & Sons,Inc.,2008
3. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY,USA.

REFERENCES:

1. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition,2016.
2. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble&Shel Israel, Patrick Brewster Press; 1 edition,2016.
3. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition,2015.
4. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition,2014.
5. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition2015.

COURSE OUTCOMES (COs)	
CO1	To understand virtual reality, augmented reality and using them to build engineering applications
CO2	To develop software that reflects fundamental techniques for the design and deployment of AR experiences.
CO3	To Analyse& Design a system or process to meet given specifications with realistic engineering constraints.
CO4	Identify and examine state-of-the-art AR design problems and solutions from the industry and academia.
CO5	To develop AR applications with betteroptimality
CO6	To evaluate the benefits and drawbacks of specific VR techniques on the human body.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	H				H			M
CO2	H	H	H	H	H				H			M
CO3	H	H	H	H	H				H			M
CO4	H	H	H	H	H				H			M
CO5	H	H	H	H	H				H			M
CO6	H	H	H	H	H				H			M

UNIT I INTRODUCTION TO BLOCKCHAIN AND HOW TO STORE AND USE 9

Block chain Achieves and How to Store and Use Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus with- out identity using a blockchain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

UNIT II INTRODUCTION TO CRYPTOGRAPHY AND MECHANICS OF BITCOIN 9

Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency. Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bit- coin network, Limitations and improvements.

.UNIT III BITCOIN MINING AND BITCOIN AND ANONYMITY 9

The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies.Anonymity Basics, How to De-anonymizeBitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash.

UNIT IV COMMUNITY, POLITICS, AND REGULATION 9

Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Who‟s in Charge, Roots of Bitcoin, Governments Notice on Bitcoin, Anti Money Laundering Regulation, New York‟s Bit License Proposal. Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as Smart Property, Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-Prediction Markets, and Real World Data Feeds.

UNIT V ALTCOINS AND THE CRYPTOCURRENCY ECOSYSTEM 9

Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Crosschain Swaps-6 BitcoinBackedAltcoins, Side Chains, Ethereum and Smart Contracts.

Text Book(s)

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. (2016). Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press.

Reference Books

1. Antonopoulos, A. M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies. OReilly Media, Inc.”.
2. Franco, P. (2014). Understanding Bitcoin: Cryptography, engineering and economics. John Wiley and Sons.William Stalling, “ Cryptography and Network security”, Pearson.

COURSE OUTCOMES (COs)	
CO1	Should be able to understand the mechanism of Blockchain and Cryptocurrency
CO2	To understand the functionality of current implementation of blockchain technology.
CO3	To understand the required cryptographic background.
CO4	To explore the applications of Blockchain to cryptocurrencies and understanding limitations of current Blockchain
CO5	To gain knowledge about various operations associated with the life cycle of Blockchain and Cryptocurrency
CO6	To demonstrate the general ecosystem of several Cryptocurrency

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) **H-High, M – Medium, L-Low**												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	L	H	H	H	L	M					M	M
CO2	L	H	H	H	L	M					M	M
CO3	L	H	H	H	L	M					M	M
CO4	L	H	H	H	L	M					M	M

CO5	L	H	H	H	L	M					M	M
CO6	L	H	H	H	L	M					M	M
Category	Programme Elective (PE)											

U18PECS063	**BIG DATA FOR HEALTHCARE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Data Structures and algorithms				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To understand the basics of data analytics in Healthcare system
- To learn how to utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
- To design, implement and deploy mobile applications using an appropriate software development environment.

UNIT IINTRODUCTIONTO BIG DATA IN HEALTHCARE SYSTEM 9

Basics of data analysis for the healthcare system – Health data standards - Healthcare Data Acquisition and Management - Applied Statistics for Healthcare Analytics - Quantitative Methods in Healthcare Management - Data Mining for Healthcare Analytics - Systems Medicine for Predictive Analytics

UNIT-II HDFS, HADOOP AND HADOOP INFRASTRUCTURE 9

Hadoop and Databases - Typical Datacenter Architecture - Adding Hadoop to the Mix - Key Benefit -· Flexibility: Complex Data Processing - HDFS - Hadoop Infrastructure -Architecture – Different in Data Model and Computing Model – HDFS Files and Blocks , Components of HDFS - Hadoop framework - HDFS-Map Reduce Framework-Data Loading techniques-Hadoop Cluster Architecture-Hadoop Configuration files-Hadoop Cluster modes-Single Node-Multi Node-Fully distributed node.

UNIT-III HADOOP MAP REDUCE FRAMEWORK 9

Relationship between MapReduce and HDFS- Relationship between MapReduce and HDFS-Clients, Data Nodes, and HDFS Storage - MapReduce workloads. Hadoop framework- Hadoop data types-Hadoop map reduce Paradigm-Map and Reduce Tasks-Map reduce Execution framework-Partitioners and Combiners-Input formats (Input Splits and Records, Text Input, Binary Input, Multiple Inputs)- Output Formats (TextOutput, BinaryOutPut, Multiple Output)-Hadoop Mapreduce programming-Advanced Map reduce concepts- Counters, Custom Writables-Unit testing framework-Error Handling-Tuning-Advanced Map reduce.

UNIT-IVHADOOP IMPLEMENTATION AND HADOOP ECO SYSTEM TOOLS9

Hadoop Implementation - · Job Execution - · Hadoop Data Types - · Job Configurations - · Input and Output Formats ECO system tools- Pig's Data Model, Pig Latin, Developing & Testing Pig Latin Scripts- Writing Evaluation, Filter, Load & Store Functions-Hive- Hive Architecture- Comparison with Traditional Database- HiveQL: Data Types, Operators and Functions- Hive Tables- Querying Data-Advance Hive, NoSQL Databases -HBase-Loading Data in Hbase-Querying Data in Hbase

UNIT-V HADOOP PROJECT ENVIRONMENT 9

HBase: Introduction to HBase, Client API's and their features, Available Client, HBase

Architecture, MapReduce Integration. HBase: Advanced Usage, Schema Design, Advance Indexing, Coprocessors, Hadoop 2.0- MRv2 –YARNNameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN, Upgrade your existing MRv1 code to MRv2, Programming in YARN framework-cover Apache Oozie Workflow Scheduler for Hadoop

TEXTBOOK:

1. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS BusinessSeries, 2012.
2. WA Gmob, "Big Data and Hadoop", Kindle Edition, 2013
3. Eric Miller, "An Overview of Map Reduce and its impact on Distributed Data", Kindle Edition, 2012.

REFERENCE BOOKS:

1AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge UniversityPress, 2012.

2.**http://www.mosaic.geo-strategies.com/wp-content/uploads/2013/10/Big-Data-for-Dummies.pdf**

COURSE OUTCOMES (COs)	
CO1	Understand the key issues in big data management in healthcare applications
CO2	Design, implement and deploy mobile applications using an appropriate software development environment.
CO3	Understand rapid prototyping techniques.
CO4	Develop sophisticated mobile interfaces.
CO5	Acquire fundamental enabling techniques and scalable algorithms like Hadoop
CO6	Develop applications for current and emerging mobile computing devices, performing tasks at all stages of the software development life-cycle.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M	H				H	M	H		H	M	
CO2	H		H	H	H							
CO3	H		H	H	H							
CO4	H		H	H	H							
CO5	H	H	M		H							
CO6			H	H	H							
Category	Professional Course (PC)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PECS064	**MEDICAL IMAGING AND INVERSE PROBLEM**	**L**	**T**	**P**	**C**

	Total Contact Hours: 45	3	0	0	3
	Prerequisite: IMAGE PROCESSING,DIGITAL SIGNAL PROCESSING				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

To provide an in-depth knowledge about Medical image processing that requires a comprehensive environment for data access, analysis, processing, visualization, and algorithm development.

UNIT I INTRODUCTION 9

Introduction to Medical Imaging Technology, Systems, and Modalities- Brief history importance, applications, trends, challenges- Medical Image Formation Principles: X-Ray physics, Basic principles of CT, artifacts, CT hardware, Magnetic Resonance Imaging (MRI), Mathematics of MRI, NMR Spectroscopy Imaging Principles and Hardware, Image artifacts

UNIT II IMAGE ENHANCEMENT AND IMAGE RESTORATION9

Basic gray level transformation - Histogram equalization and histogram matching - Image smoothening, Image sharpening, both spatial and frequency domain - Color image Processing color models, Pseudo color image processing - Image degradation models, restoration - mean filter, order statistics filter, adaptive filters

UNIT III MEDICAL IMAGE ANALYSIS9

Medical Image Segmentation- Region based Segmentation, Edge based Segmentation, Model based Segmentation, Multi scale segmentation and semi-automated Segmentation, Clustering based methods - Classification based methods- Medical Image Registration- Cost functionalities and Optimization Techniques.

UNIT IV INTRODUCTION TO INVERSE PROBLEMS 9

Examples of direct (forward) problems: deterministic and statistical point of view - The deconvolution problem: An Illustrative example - Truncated Fourier decomposition (TFD); Regularization parameter selection - Bayesian perspective Iterative optimization - Optimization algorithms: smooth convex objective functions, non-smooth convex objective functions

UNIT V REGULARIZATION OF LINEAR OPERATORS IN FUNCTION SPACES 9

Singular value decomposition (SVD) - Least squares solution; Mooren - Penrose pseudo inverse - Geometry of a linear inverse problem - Minimization of quadractic functionals - Regularization theory : Tickhonov regularization - Truncated SVD - Generalized Tikhonov /Bayesian regularization - Examples of inverse problems : Image denoising, X-ray tomography.

TEXT BOOKS:

1. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.

2. Atam p. Dhawan, “Medical Image Analysis”, Second Edition, Wiley-IEEE Press.

REFERENCES:

1. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume Medical Image Processing and Analysis", SPIE Publications, 2009.

2. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.

COURSE OUTCOMES (COs)	
CO1	To learn medical image fundamentals and processing techniques
CO2	Describe the various image enhancement and image restoration techniques
CO3	To learn various segmentation, classification and clustering methods in Medical Image processing.
CO4	To learn the fundamentals of inverse problems in medical imaging
CO5	To apply Optimization algorithmsin medical imaging techniques
CO6	To evaluate linear operators in function spaces for inverse problems

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1			L									
CO2	M		L		M							
CO3	M		M	L							L	
CO4	H	M	M	L	M						L	
CO5	L		M		L							
CO6		M		M								

	HIGH PERFORMANCE COMPUTING TOOLS AND APPLICATIONS	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – High Performance Computing				
	Course Designed by – Dept. of Computer Science & Engineering				

OBJECTIVES

This course helps students to study parallel models of computation such as dataflow, and demand-driven computation.

- Introduce the fundamentals of high performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments.
- Introduce the learner to fundamental and advanced parallel algorithms through basic techniques.
- Provide systematic and comprehensive treatment of the components in the pipeline that extract

instruction level parallelism.

UNIT -1 Introduction: Computational Science and Engineering 9

Computational Science and Engineering: Computational Science and Engineering Applications; characteristics and requirements, Review of Computational Complexity, Performance: metrics and measurements, Granularity and Partitioning, Locality: temporal/spatial/stream/kernel, Basic methods for parallel programming, Real-world case studies (drawn from multiscale, multi-discipline applications)

Unit-2 High-End Computer Systems 9

Memory Hierarchies, Multi-core Processors: Homogeneous and Heterogeneous, Shared-memory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators / Reconfigurable Computing, Novel computers: Stream, multithreaded, and purpose-built

Unit-3 Parallel Algorithms 9

Parallel models: ideal and real frameworks, Basic Techniques: Balanced Trees, Pointer Jumping, Divide and Conquer, Partitioning, Regular Algorithms: Matrix operations and Linear Algebra, Irregular Algorithms: Lists, Trees, Graphs, Randomization: Parallel Pseudo-Random Number Generators, Sorting, Monte Carlo techniques

Unit-IV Parallel Programming 9

Revealing concurrency in applications, Task and Functional Parallelism, Task Scheduling, Synchronization Methods, Parallel Primitives (collective operations), SPMD Programming (threads, OpenMP, MPI), I/O and File Systems, Parallel Matlabs (Parallel Matlab, Star-P, Matlab MPI), Partitioning Global Address Space (PGAS) languages (UPC, Titanium, Global Arrays)

Unit-5 Achieving Performance 9

Measuring performance, Identifying performance bottlenecks, Restructuring applications for deep memory hierarchies, Partitioning applications for heterogeneous resources, using existing libraries, tools, and frameworks

TEXT BOOKS

1. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 3e.
2. Rezaur Rahman, Intel Xeon Phi Coprocessor Architecture and Tools, Apress Open, 2013.
3. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP, MIT Press, 2008.

REFERENCE BOOKS

1. Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
2. "Principles and Practices on Interconnection Networks", by William James Dally and Brian Towles, Morgan Kauffman 2004.
3. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, © 2003.
4. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.

COURSE OUTCOMES (COs)	
CO1	To understand the basics on parallel processing concepts.
CO2	Implement high performance versions of standard single threaded

	algorithms
CO3	Extract maximum performance in a multicore, shared memory execution environment processor.
CO4	Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm
CO5	Gain experience with leading-edge performance analysis tools.
CO6	Learn the consistency problems in multiprocessors, and their existing solutions

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	H	H	H	H	L							
CO2	H	H	H	H	M	L						
CO3	H	H	H	H	H						M	H
CO4	H	H	H	H	H						M	H
CO5	H	H	H	H	H	L			M		M	H
CO6	H	H	H	H	H				M		M	H

U18PECS066	**ENTERPRISE APPLICATION INTEGRATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Software Architecture Design				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Describe approaches to enterprise application integration
- Understand the integration middleware
- Evaluate the integration approaches suitable for a given problem

UNIT I INTRODUCTION **9**

Requirements for EAI - Challenges in EAI – Integration with legacy systems – Integration with partners - Heterogeneous environment – Implementation approaches – Web services, messaging, ETL, direct data integration – Middleware requirements – Approaches to integration – services oriented and messaging.

UNIT II INTEGRATION PATTERNS **9**

Introduction to integration patterns – Architecture for application integration – Integration patterns – Point to point, broker, message bus, publish/subscribe, Challenges in performance, security, reliability - Case studies

UNIT III SERVICE ORIENTED INTEGRATION **9**

Business process integration - Composite applications-services – Web services – Service choreography and orchestration - Business process modeling - BPMN, Business process execution - BPEL – Middleware infrastructure - Case studies

UNIT IV MESSAGING BASED INTEGRATION **9**

Messaging – Synchronous and asynchronous – Message structure – Message oriented middleware – Reliability mechanisms – Challenges – Messaging infrastructure – Java Messaging Services – Case studies

UNIT V ENTERPRISE SERVICE BUS **9**

Enterprise Service Bus – routing, scalable connectivity, protocol and message transformations, data enrichment, distribution, correlation, monitoring – Deployment configurations – Global ESB, Directly connected, Federated, brokered ESBs – Application server based – Messaging system based – Hardware based ESBs – Support to SOA, message based and event based integrations - Case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. George Mentzas and Andreas Frezen (Eds), "Semantic Enterprise Application Integration for Business Processes: Service-oriented Frameworks", Business Science Reference, 2009
2. Waseem Roshen, "SOA Based Enterprise Integration", Tata McGrawHill, 2009.
3. G Hohpe and B Woolf, "Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions", Addison Wesley Professional, 2003
4. D Linthicum, "Next Generation Application Integration: From Simple Information to Web Services", Addison Wesley, 2003
5. Martin Fowler, "Patterns of Enterprise Application Architecture", Addison- Wesley, 2003
6. Kapil Pant and Matiaz Juric, "Business Process Driven SOA using BPMN and BPEL: From Business Process Modeling to Orchestration and Service Oriented Architecture", Packt Publishing, 2008.

COURSE OUTCOMES:

CO1	Describe different approaches to integration enterprise applications
CO2	Analyze specifications and identify appropriate integration approaches
CO3	Upon Completion of the course, the students will be able to
CO4	Develop a suitable integration design for a given problem
CO5	Identify appropriate integration middleware for a given problem
CO6	Evaluate the integration approaches against specified requirements

CO/PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M											
2		S										
3	S											
4		M										
5	S											
6		M										

OPEN ELECTIVE

U18OECS001	**MOBILE APPLICATION DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

This course is concerned with the development of applications on mobile and wireless compu platforms. Android will be used as a basis for teaching programming techniques and design patt related to the development of standalone applications and mobile portals to enterprise and commerce systems. Emphasis is placed on the processes, tools and frameworks required to deve applications for current and emerging mobile computing devices.

UNIT- I INTRODUCTION 9

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT –II ANDROID APPLICATIONS 9

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT-III USER INTERFACE 9

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

UNIT- IV TESTING AND DEPLOYMENT 9

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT- V ANDROID API 9

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

TEXT BOOKS:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd edition. (2011)

REFERENCES:

1.Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

COURSE OUTCOMES (COs)	
CO1	Identify various concepts of mobile programming that make it unique from programming for other platforms.
CO2	Critique mobile applications on their design pros and cons.
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features.
CO5	Deploy applications to the Android marketplace for distribution.

CO6	To apply Managing data using Sqlite and Sharing Data between Applications with Content Providers.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M		H		M							
CO2	M		H		M							
CO3	M		H		M							
CO4	M		H		M							
CO5	M		H		M							
CO6	M		H		M							
Category	Open Elective (OE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18OECS002	**SYSTEM MODELLING AND SIMULATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The overall aim of the course is to provide an understanding of Methods, techniques and tools modeling, simulation and performance analysis of complex systems such as communication computer networks.

UNIT-I OVERVIEW OF PERFORMANCE EVALUATION 9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems.

UNIT-II MARKOV CHAINS AND SIMPLE QUEUES 9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1 and PASTA.

UNIT-III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT-IV REAL-WORLD WORKLOADS 9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Analytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT-V SMART SCHEDULING IN THE M/G/1 9

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

TEXT BOOKS

1. MorHarchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press, 2013.

2. LievenEeckhout, “Computer Architecture Performance Evaluation Methods”, Morgan and Claypool Publishers, 2010.

REFERENCES

1. Paul J. Fortier and Howard E. Michel, “Computer Systems Performance Evaluation and Prediction”, Elsevier, 2003.

COURSE OUTCOMES (COs)	
CO1	Define basic concepts in modeling and simulation (M&S)
CO2	Classify various simulation models and give practical examples for each category
CO3	Construct a model for a given set of data and motivate its validity
CO4	Generate and test random number varieties and apply them to develop simulation models.
CO5	Analyze output data produced by a model and test validity of the model.
CO6	To apply Performance Metrics and Non-Preemptive and Preemptive Scheduling

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M		M									
CO2	M		M									
CO3	M		M									
CO4	M		M									
CO5	M		M									
CO6	M		M									
Category	Open Elective (OE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18OECS003	**WEB PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The objective of Web Services is Build web based application using sockets.

UNIT I SCRIPTING

Web page Designing using HTML, Scripting basics- Client side and server side scripting. Java Script-Object, names, literals, operators and expressions- statements and features- events - windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.-HTML5- CSS3- HTML 5 canvas - Web site creation using tools.

UNIT II JAVA

Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces –Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling.

UNIT III JDBC

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– InetAddress class – URL class- TCP sockets

- UDP sockets, Java Beans –RMI.

UNIT IV APPLETS

Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP.

UNIT V XML AND WEB SERVICES

Xml – Introduction-Form Navigation-XML Documents- XSL – XSLT- Web services-UDDI-WSDL-Java web services – Web resources.

REFERENCES:

1. Behrouz A. Forouzan, Data Communications and Networking, Fourth Ed., Tata McGraw Hill, 2006.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, Fourth Ed., Morgan Kaufmann, 2007.
3. Markus Hoffmann and Leland R. Beaumont, Content Networking: Architecture, Protocols, and Practice, Morgan Kauffman, 2005.
4. **http://www.cs.wayne.edu/~hzhang/courses/7290/Lectures/0-0%20-%20Course%20plan.pdf**

COURSE OUTCOMES (COs)	
CO1	To understand the concept of Web Application Development and its Architecture.
CO2	To understand the Essentials of Web Application Development.
CO3	To understand and practice web page designing techniques.
CO4	To understand and practice embedded dynamic scripting on client side Internet Programming.
CO5	To understand the differences between client side & server side technologies to develop Web Application
CO6	To apply XML and Web Services concepts.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	M		H		M							
CO2	M		H		M							
CO3	M		H		M							
CO4	M		H		M							
CO5	M		H		M							
CO6	M		H		M							
Category	Open Elective (OE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18OECS004	VIRTUAL REALITY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

This course gives to explore the concepts of the concepts of virtual Reality systems and its Applications. Basic virtual Reality systems functions(operations) virtual Reality design considerations

UNIT I INTRODUCTION **9**

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- 3D Computer Graphics : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – Human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms.

UNIT II GEOMETRIC MODELING GEOMETRICAL TRANSFORMATIONS GEOMETRIC MODELING: **9**

Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual

UNIT III ANIMATING THE VIRTUAL ENVIRONMENT: **9**

Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non-linear translation - shape & object inbetweening – freeform deformation – particle system- Physical Simulation : Introduction – Objects falling in a graphical field –Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft

UNIT IV VR HARDWARES & SOFTWARES **9**

Human factors : Introduction – the age- the ear- the somatic senses - VR Hardware : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems-VR Software: Introduction – Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

UNIT V VR APPLICATION **9**

Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction

TEXT BOOK

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2002

REFERENCE BOOKS

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology” , WileyInterscience,1 Edition,1994.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”,Morgan Kaufmann, 1st Edition,2002.

ONLINE REFERENCES

www.vresources.org
www.vrac.iastate.edu
www.w3.org/MarkUp/VRML/

COURSE OUTCOMES (COs)	
CO1	To learn The basic of virtual Reality systems.
CO2	The concepts of virtual Reality systems and its applications.
CO3	Basic virtual Reality systemsfunctions(operations) virtual Reality design considerations.
CO4	Integration of Hardware and software in virtual Reality applications.
CO5	Virtual Reality design considerations.
CO6	Integration of Hardware and software in virtual Reality applications.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	L	H	H	H	L	M					M	M
CO2	L	H	H	H	L	M					M	M
CO3	L	H	H	H	L	M					M	M
CO4	L	H	H	H	L	M					M	M
CO5	L	H	H	H	L	M					M	M
CO6	L	H	H	H	L	M					M	M
Category	Open Elective (OE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18OECS005	**E COMMERCE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

This course Discuss the current drivers and inhibitors facing the business world in adopting using Ecommerce.

UNIT-I ELECTRONIC COMMERCE 9

Electronic Commerce, Electronic Data Interchange (EDI), E-Commerce Types – PC and networking: Networking, Communication media – Computer Communication Systems: ISO model, Electronic mail, X.400 Message Handling System, E-mail security, Lightweight directory access protocol – Internet: Introduction, Communication protocols, Issues of concern.

UNIT-II ELECTRONIC DATA INTERCHANGE 9

EDI: Introduction, Cost and Benefits, Components of EDI System, Implementation Issues – UN/EDIFACT Standard: Introduction, An EDIFACT Message, Interchange Structure,

Message Directories - EDI Over Internet, Commerce Over Extranets, Identification and Tracking Tools.

UNIT-III BUSINESS PROCESS REENGINEERING 9

Business process reengineering – Approach to BPR, BPR methodology – Change management: Change management in the Government, Implementation plan.

CONCERNS FOR E-COMMERCE GROWTH

Legal issues, Risks: Paper document versus electronic document, Technology for authenticating an electronic document, Laws for e-commerce, EDI interchange agreement.

UNIT-IV CYBER SECURITY 9

Cyber Attacks, Hacking, Firewalls, IDS, Secure Sockets Layer, Symmetric and asymmetric crypto systems, Guidelines for Cryptography Policy, Developing a Security Policy.

CYBER CRIMES: Cybercrimes and the Information Technology Act, 2000, Cyber forensics

UNIT-V CASE STUDIES 9

E-Commerce: Case Studies: ITC's e-Choupal - E-Governance: Case Studies: Indian customs EDI System, Indian Railways, Government of Andhra Pradesh – eSeva.

COMPUTER EMERGENCY RESPONSE TEAM (CERT): Introduction, CERT-In, CERT-In Activities.

REFERENCE BOOKS:

1. Kamlesh K Bajaj, Debjani Nag, "E-Commerce – The Cutting Edge of Business", Tata McGraw Hill, Second Edition, 2006
2. David Whitley, "E-Commerce: Strategy, Technologies and applications", McGraw Hill, 2000.

COURSE OUTCOMES (COs)	
CO1	Create and refine website and application designs based on industry's usability.
CO2	Assess the suitability of various design principles for websites and applications.
CO3	Apply the skills necessary for large-scale project development on the Web.
CO4	Apply the technologies required to design and prototype Web-based information system
CO5	Recognize the business impact and potential of E-Commerce.
CO6	To analyze various case studies in electronic commerce.

Mapping of Course Outcomes with PROGRAMME OUTCOMES(POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COs	**Programme Outcomes(POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1							H	M			M	
CO2							H	M			M	
CO3							H	M			M	
CO4							H	M			M	
CO5							H	M			M	
CO6							H	M			M	
Category	Open Elective (OE)											
Approval	47th Academic Council Meeting held in Aug, 2018											

CURRICULUM AND SYLLABUS

(R2018)

B–FACT: Bharath -**F**lexible **A**ccommodative **C**hoice Based Credit System For **T**echnology

(Applicable to the batches admitted from July 2018)

B.Tech –ELECTRONICS AND COMMUNICATION ENGINEERING

(FULL TIME)

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics - I	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	0
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
Total				37	14	1	22	22.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics II	4	3	1	0	4
3	U18BSPH202	BS	Semi Conductor Physics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L2	BS	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	U18MCAB102	MC	Gardening & Tree Plantation	2	0	0	2	0
			Total	34	15	2	17	23.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA301	BS	Transforms and Partial Differential equation	4	3	1	0	4
2	U18PCEC301	PC	Signals and Systems	4	3	1	0	4
3	U18PCEC302	PC	Digital System design	3	3	0	0	3
4	U18PCEC303	PC	Electronic Devices	3	3	0	0	3
5.	U18PCEC304	PC	Network Theory	3	3	0	0	3
6	U18HSEC301	HS	Professional Ethics	3	3	0	0	3
PRACTICAL								
7	U18PCEC3L1	PC	Electronic devices Lab	2	0	0	2	1
8	U18PCEC3L2	PC	Digital System design lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage (festivals, Food ways, Local games)	2	0	0	2	0
			Total	28	18	2	8	22

SEMESTER IV								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA404	BS	Probability and Stochastic Process	4	3	1	0	4
2	U18PCEC401	PC	Analog and Digital Communication	3	3	0	0	3
3	U18PCEC402	PC	Analog Circuits	3	3	0	0	3
4	U18PCEC403	PC	Microcontrollers	3	3	0	0	3
5.	U18PCEC404	PC	Electromagnetic Waves	3	3	0	0	3
6	U18ESCS401	ES	Object Oriented Programming and Data Structures	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
8	U18HSBA401	HS	Organizational Behavior	3	3	0	0	3
PRACTICAL								
9	U18PCEC4L1	PC	Analog and Digital communication Lab	2	0	0	2	1
10	U18PCEC4L2	PC	Microcontrollers Lab	2	0	0	2	1
11	U18PCEC4L3	PC	Analog Circuits Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	34	23	1	10	25

SEMESTER V								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCEC501	PC	Digital Signal Processing	4	3	1	0	4
2	U18PCEC502	PC	Transmission lines and waveguides	4	3	1	0	4
3	U18PCEC503	PC	Antennas and Propagation	4	3	1	0	4
4	U18PCEC504	PC	Microwave theory and techniques	4	3	1	0	4
5.		PE	Professional Elective-I	3	3	0	0	3
6	U18MCTH401	MC	Constitution of India	2	2	0		0
PRACTICAL								
8	U18PCEC5L1	PC	Digital Signal Processing	2	0	0	2	1
9	U18PCEC5L2	PC	Microwave Engineering Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	29	17	4	8	21

SEMESTER VI								
S.NO	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCEC601	PC	Control System	4	3	1	0	4
2	U18PCEC602	PC	Computer Network	3	3	0	0	3
3	U18PCEC603	PC	Biomedical Instrumentation	3	3	0	0	3
4		PE	Professional Elective-II	3	3	0	0	3
5.		OE	Open Elective-I	3	3	0	0	3
PRACTICAL								
7	U18PCEC6L1	PC	Computer Networks Lab	2	0	0	2	1
8	U18PCEC6L2	PC	Electronic Measurement Lab	2	0	0	2	1
9	U18EEEC6L3	EE	Electronic Design Project	4	0	0	4	2
ACTIVITY BASED COURSES								
10	U18MCAB611	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB612	MC	Self-Development - religion and Inter-faith	2	0	0	2	0
			Total	28	15	1	2	20

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCEC701	PC	Embedded Systems	3	3	0	0	3
2		PE	Professional Elective-III	3	3	0	0	3
3		PE	Professional Elective-IV	3	3	0	0	3
4		PE	Professional Elective- V	3	3	0	0	3
5		PE	Professional Elective-VI	3	3	0	0	3
6	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
7	U18EEEC7P1	EE	Project Stage-I	6	0	0	6	3
ACTIVITY BASED COURSES								
8	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
9	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	27	17	0	10	18

SEMESTER VIII								
S. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		OE	Open Elective- II	3	3	0	0	3
2		OE	Open Elective- III	3	3	0	0	3
3		OE	Open Elective-IV(MOOC)	2	2	0	0	2
PRACTICAL								
4	U18EEEC8P2	EE	Project Stage-II	18	0	0	18	9
ACTIVITY BASED COURSES								
5	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	28	8	0	20	17

Total No of Credits in the Programme: 169
Total No of Contacts in the Programme: 245

LIST OF PROFESSIONAL ELECTIVES

Professional Elective –I

S. NO	Course Code	Specialization	Course Title		L	T	P	C
1	U18PEEC011	Communication Engineering	Information Theory and Coding		3	0	0	3
2	U18PEEC012	Signal processing	Speech and Audio Processing		3	0	0	3
3	U18PEEC013	Networking	Cellular Mobile Communication		3	0	0	3
4	U18PEEC014	VLSI design	FPGA and System on Chip Design		3	0	0	3
5	U18PEEC015	Embedded system	Design of Semiconductor Memories		3	0	0	3
6	U18PEEC016	Signal processing	Mixed Signal Design		3	0	0	3

Professional Elective –II

S. NO	Course Code	Specialization	Course Title	L	T	P	C
1	U18PEEC021	Communication Engineering	Error Correcting Codes	3	0	0	3
2	U18PEEC022	Networking	Wireless Communication Networks	3	0	0	3
3	U18PEEC023	Networking	Wireless Sensor Networks	3	0	0	3
4	U18PEEC024	Embedded system	ASIC Design	3	0	0	3
5	U18PEEC025	VLSI design	Testing and Verification of Electronic Circuits	3	0	0	3
6	U18PEEC026	Signal processing	Statistical Signal Processing	3	0	0	3

Professional Elective –III

S. NO	Course Code	Specialization	Course Title	L	T	P	C
1	U18PEEC031	Communication Engineering	Cognitive radio	3	0	0	3
2	U18PEEC032	Communication Engineering	Ultra-wideband Communication	3	0	0	3
3	U18PEEC033	Networking	Broadband Network	3	0	0	3
4	U18PEEC034	Networking	Network Services	3	0	0	3
5	U18PEEC035	Embedded Systems	Internet of Things and Machine learning	3	0	0	3
6	U18PEEC036	VLSI design	System Modeling and Design	3	0	0	3
7	U18PEEC037	Signal Processing	Adaptive Signal Processing	3	0	0	3

Professional Elective -IV

S. NO	Course Code	Specialization	Course Title	L	T	P	C
1	U18PEEC041	Communication Engineering	Cryptography and Network Security	3	0	0	3
2	U18PEEC042	Networking	Routing Protocols	3	0	0	3
3	U18PEEC043	Embedded Systems	Robotics and Automation	3	0	0	3
4	U18PEEC044	VLSI Design	Nano Electronics	3	0	0	3
5	U18PEEC045	Signal Processing	Wavelets	3	0	0	3
6	U18PEEC046	Signal Processing	Pattern Recognition and Neural Networks	3	0	0	3

Professional Elective -V

S. NO	Course Code	Specialization	Course Title	L	T	P	C
1	U18PEEC051	Communication Engineering	Satellite Communication	3	0	0	3
2	U18PEEC052	Networking	High Performance Communication and Networks	3	0	0	3
3	U18PEEC053	Embedded System	Real Time Systems	3	0	0	3
4	U18PEEC054	VLSI design	Digital Hardware Design	3	0	0	3
5	U18PEEC055	Signal Processing	Medical Image Processing	3	0	0	3
6	U18PEEC056	Signal processing	Digital Image & Video Processing	3	0	0	3

Professional Elective -VI

S. NO	Course Code	Specialization	Course Title	L	T	P	C
1	U18PEEC061	Communication Engineering	RF Communication Circuits	3	0	0	3
2	U18PEEC062	Communication Engineering	Telecom Networks	3	0	0	3
3	U18PEEC063	Networking	Wireless Adhoc Networks	3	0	0	3
4	U18PEEC064	Embedded system	Embedded C and LINUX	3	0	0	3
5	U18PEEC065	VLSI design	High Speed Electronics	3	0	0	3
6	U18PEEC066	Signal processing	Multimedia Compression and Communication	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES
ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18oeBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle

39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS004-Mobile Application Development
72. U18OECS005-System Modelling and Simulation
73. U18OECS006-Web Programming
74. U18OECS007-Virtual Reality
75. U18OECS008- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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LIST OF COURSES CATEGORYWISE

HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

S. No	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	Communicative English	4	2	0	2	3
2	U18HSEN201	Technical English	3	2	1	0	3
3	U18HSEC301	Professional Ethics	3	3	0	0	3
4	U18HSBA401	Organizational Behavior	3	3	0	0	3
Total Credit							12

MATHS & BASIC SCIENCES (BS)

S. No	Code No	Course Title	Contact Periods	L	T	P	C
1	U18BSMA101	Engineering Mathematics – I	4	3	1	0	4
2	U18BSPH101	Waves and Optics	3	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	3	0	0	3
4	U18BSBT101	Biology for Engineers	2	2	0	0	2
5	*U18BSPH2L2	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	0
6	*U18BSCH2L4	Chemistry Lab	3	0	0	3	0
7	U18BSMA201	Engineering Mathematics II	4	3	1	0	4
8	U18BSPH202	Semi Conductor Physics	3	3	0	0	3
9	U18BSCH201	Environmental Sciences	3	3	0	0	3
10	*U18BSPH2L2	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	1.5
11	*U18BSCH2L4	Chemistry Lab	3	0	0	3	1.5
12	U18BSMA301	Transforms and Partial Differential equation	4	3	1	0	4
13	U18BSMA405	Probability and Stochastic Process	3	3	0	0	3
Total Credits							32

ENGINEERING SCIENCES (ES)

S. No	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18ESEE101	Basic Electrical and Electronics Engineering	3	0	0	3	3
2	U18ESME1L2	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
3	U18ESEE1L3	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
4	U18ESCS101	Problem Solving and Python Programming	3	3	0	0	3

5	U18ESME101	Engineering Graphics & Design	5	1	0	4	3
6	U18ESCS1L1	Problem Solving and Python Programming Lab	3	0	0	3	1.5
7	U18ESCS401	Object Oriented Programming and Data Structures	3	3	0	0	3
Total Credits							18

PROFESSIONAL CORE (PC)

S. No	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18PCEC301	Signals and Systems	4	3	1	0	4
2	U18PCEC302	Digital System design	3	3	0	0	3
3	U18PCEC303	Electronic Devices	3	3	0	0	3
4	U18PCEC304	Network Theory	3	3	0	0	3
5	U18PCEC401	Analog and Digital Communication	4	3	1	0	3
6	U18PCEC402	Analog Circuits	3	3	0	0	3
7	U18PCEC403	Microcontrollers	3	3	0	0	3
8	U18PCEC404	Electromagnetic Waves	3	3	0	0	3
9	U18PCEC501	Digital Signal Processing	4	3	1	0	4
10	U18PCEC502	Transmission lines and waveguides	4	3	1	0	4
11	U18PCEC503	Antennas and Propagation	4	3	1	0	4
12	U18PCEC504	Microwave theory and techniques	4	3	1	0	4
13	U18PCEC601	Control System	4	3	1	0	4
14	U18PCEC602	Computer Network	3	3	0	0	3
15	U18ESEC603	Biomedical Instrumentation	3	3	0	0	3
16	U18PCEC701	Embedded System	3	0	0	3	3
1	U18PCEC3L1	Electronic devices Lab	2	0	0	2	1
2	U18PCEC3L2	Digital System design lab	2	0	0	2	1
3	U18PCEC4L1	Analog and Digital communication Lab	2	0	0	2	1
4	U18PCEC4L2	Microcontrollers Lab	2	0	0	2	1
5	U18PCEC4L3	Analog Circuits Lab	2	0	0	2	1
6	U18PCEC5L1	Digital Signal Processing Lab	2	0	0	2	1
7	U18PCEC5L2	Microwave Engineering Lab	2	0	0	2	1
8	U18PCEC6L1	Computer Networks Lab	3	0	0	2	1
9	U18PCEC6L2	Electronic Measurement Lab	2	0	0	2	1
Total Credits							63

EMPLOYABILITY ENHANCEMENT (EE) COURSES

1	U18EEEC6L3	Electronic Design Project	4	0	0	4	2
2	U18EEEC7P1	Project Stage-I	6	0	0	6	3
3	U18EEEC8P2	Project Stage-II	18	0	0	18	9
Total Credits							14

MANDATORY COURSES (MC)

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18MCTH502	Universal Human Values	2	2	0	0	0
2	U18MCTH401	Constitution of India	2	2	0	0	0
3	U18MCTH603	Essence of Indian Knowledge Tradition	2	2	0	0	0
1	U18MCAB203	Yoga	2	0	0	2	0
2	U18MCAB204	Physical health – NCC	2	0	0	2	0
3	U18MCAB101	Physical health – Sports & Games	2	0	0	2	0
4	U18MCAB102	Gardening & Tree Plantation	2	0	0	2	0
5	U18MCAB305	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	Culture – Intangible Cultural, heritage (festivals, Food ways, Local games)	2	0	0	2	0
7	U18MCAB407	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
8	U18MCAB408	Literature & Media – Group Reading of Classics	2	0	0	2	0
9	U18MCAB509	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	Social Services – NSS	2	0	0	2	0
11	U18MCAB611	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	Self-Development - religion and Inter-faith	2	0	0	2	0
13	U18MCAB613	Behavioral and interpersonal skills	2	0	0	2	0
14	U18MCAB614	Nature – Nature club	2	0	0	2	0
15	U18MCAB815	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total Contact Periods 36							

Summary of Credit Distribution

S. No.	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management courses (HS)	3	3	3	3	-	-	-	-	12	7.10
2	Maths & Basic Sciences (BS)	12	13	4	4	-	-	-	-	33	19.53
3	Engineering Sciences (ES)	7.5	7.5	-	3	-	-	-	-	18	10.65
4	Professional Core (PC)	-	-	15	15	18	12	3	-	63	37.29
5	Professional Electives (PE)	-	-	-	-	3	3	12	-	18	10.65
6	Employment Enhancement Courses (EE)	-	-	-	-	-	2	3	9	14	8.28
7	Open Electives (OE)	-	-	-	-	-	3	-	6	9	5.33
8	Massive Open Online Course (MOOC)								2	2	1.18
9	Mandatory courses (MC)									0	
	Total Credit	22.5	23.5	22	25	21	20	18	17	169	100%
	Total Contact Hour	37	34	28	34	29	28	27	28	245Hrs	-

U18HSEN101	COMMUNICATIVE ENGLISH	L	T	P	C
	Total Contact Periods – 60	2	0	2	3
	Prerequisite – School English				
	Department:- Department of English				

COURSE OBJECTIVES:-
To gain fundamental knowledge of language and the uses in daily life.

UNIT I SPEAKING 6 hours

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing one self – exchanging personal information- narrating events, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6 hours

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6 hours

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6 hours

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms-phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6 hours

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely.

SOFTSKILL LABORATORY 30

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews &conversations

4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds- intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES (COs)	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO2	PSO3
2	CO1	3										3		2	2	2
	CO2		2							2						
	CO3			3							3					
	CO4				3		2									
	CO5					3		3	1							
	CO6															
3	Category	Humanities and Social Science (HS)														
4	Approval	47th Meeting of Academic Council														

U18BSMA101	ENGINEERING MATHEMATICS – I	L	T	P	C
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Department:- Department of Mathematics				

COURSE OBJECTIVES:-

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra.

It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOK:

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCES:

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
2	CO1	3				2		1			1			2	2	2
	CO2	3		3	1	2			2							
	CO3	3				2				1						
	CO4	3	2			2				1						
	CO5	3		3		2				2	1					
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSPH101	WAVES AND OPTICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Department:-Department of Physics				

COURSE OBJECTIVES:-
To gain fundamental knowledge of language and the uses in daily life.

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations,

reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A & B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOK:

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2. G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCES:

1. Brij Lal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2. R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3. BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4. Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5. H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6. Ajoy Ghatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7. O. Svelto, "Principles of Lasers", Springer, 2010
8. Online reference Wikipedia.org

COURSE OUTCOMES (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
2	CO1	3	3	2	3	2			2	3	3			2	2	2
	CO2	1	3	2	2	3			2		1	3				
	CO3	3	1			1			2	2		2				
	CO4	3	1			1			2	2		2				
	CO5	3	2	2	2				2		3	1				
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSPH101	ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Department:-Department of Chemistry				

COURSE OBJECTIVES:-

To gain fundamental knowledge of Engineering Chemistry and its applications

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by

Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. Nanocomposites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3			2		3		3		1			2	2	2
	CO2		1	3		2		3		2		1				
	CO3		2		3		1				2					
	CO4	3		2	1			2			3					
	CO5		3		1		2				3					
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Department:-Department of Electrical & Electronics Engineering				

COURSE OBJECTIVES:-

To gain fundamental knowledge of Electrical and Electronics Engineering and its applications

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOK:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.

CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.
CO6	

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	1			2				3		1		3	3	3
	CO2	3	1			2				3		1				
	CO3	3	2			2				3		1				
	CO4	3	1			2				3		1				
	CO5	3	1			2				3		1				
	CO6															
3	Category															
4	Approval	47th Meeting of Academic Council														

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Department:-Dept of Industrial Biotechnology				

COURSE OBJECTIVES: -

To provide a basic understanding of the biological systems and its applications in the industrial sector

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOK:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCES:

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure
CO2	To understand about biodiversity and its conservation
CO3	To know the fundamentals of genetics and the immune system
CO4	To create an awareness about human diseases
CO5	To give a basic knowledge of the applications of transgenics
CO6	To know the applications of bio systems in environment, medical and agricultural sectors

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3					2	2			3	2		2	2	2
	CO2	3			2		3		2	2						
	CO3	2		2			2									
	CO4							3			2	2				
	CO5	3	3					3	2	2						
	CO6	3						3				3				
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSPH2L2	**Wave Optics and Semi Conductor Physics Laboratory**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Wave Optics and Semi Conductor Physics				
	Department:-Department of Physics				

COURSE OBJECTIVES:

To impart knowledge of practical Physics to the students

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Semiconductor Physics – Circuit branches

1) Determination of Band Gap
2) Zener diode characteristics
3) p-n junction diode Characteristics
3) Transistor Characteristics
5) V-I characteristics using LDR circuit
6) Carey Foster's Bridge

COURSE OUTCOMES (COs)	
CO1	Understand the fundamental concept of optics
CO2	Understand the concept of production of ultrasonic waves
CO3	Understand the functions of semiconductor
CO4	
CO5	
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2	PSO 3
2	CO1	3		3	3				3	1	2			3	3	3
	CO2	3	3	1					3	1	2					
	CO3	1	3	3					3	1	2					
	CO4															
	CO5															
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Department:- Department of Chemistry				

COURSE OBJECTIVES:

To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method

2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES:

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen,Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3
2	CO1	3		2	2		3		3		1			3	3	3
	CO2	1	3			2		3		2		1				
	CO3		2		2						2					
	CO4	3		2				2				3				
	CO5		3		1		2				3					
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18ESME1L2	**WORKSHOP/MANUFACTURING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Department:-Department of Mechanical Engineering				

COURSE OBJECTIVES:

To educate the students on common manufacturing processes employed in Industries.

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fitting models.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
   Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

6. Demonstration **(6 Hours)**
   Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCES:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.

CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.
CO5	
CO6	

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1											3		2	2	2
	CO2			3	2							3				
	CO3		2													
	CO4	3			1							3				
	CO5															
	CO6															
3	Category	Engineering Science (ES)														
4	Approval	47th Meeting of Academic Council														

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Department:-Department of Electrical & Electronics Engineering				

COURSE OBJECTIVES:-

To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

REFERENCES:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3			3				3		2		3	3	3
	CO2	3	3			3				3		2				
	CO3	3	3			3				3		2				
	CO4	3	3			3				3		2				
	CO5	3	3			3				3		2				
	CO6	3	3			3				3		2				
3	Category															
4	Approval	47th Meeting of Academic Council														

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Department:-Department of English				

COURSE OBJECTIVES:-

To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary

Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech**.**

TEXT BOOK:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.
CO6	

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2										3		3	3	3
	CO2		3							2						
	CO3			3							3					
	CO4				2		3									
	CO5					2		2	1							
	CO6															
3	Category	Humanities and Social Science (HS)														
4	Approval	47th Meeting of Academic Council														

U18BSMA201	**ENGINEERING MATHEMATICS II**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Department:-Department of Mathematics				

COURSE OBJECTIVES:-

The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables.

Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOK:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCES:

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.
CO6	

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2		1		3				2		3		2	2	2
	CO2	3	2			3			2		1					
	CO3	3		1				2		3						
	CO4								3	2	2	1				
	CO5	3		1	1			2				3				
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSPH202	SEMICONDUCTOR PHYSICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Department:-Department of Physics				

COURSE OBJECTIVES:-

To develop physics and engineering strategies of semiconductor materials and to discuss their functionalities in modern electronic and optoelectronic devices

UNIT 1 INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS 9

Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential: Kronig - penny and nearly free electron models - Real methods for band structure calculations; Band gaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands

UNIT 2 CARRIERS AND DOPING 9

Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration – intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Band gap engineering

UNIT 3 ELECTRICAL TRANSSORT 9

Scattering Mechanism: electron - electron and electron – phonon scattering. Macroscopic transport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field and very high field.

UNIT 4 OPTICAL TRANSSORT 9

Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties. Carrier transport - continuity equations. Optical constants: Kramers - Kronig relations.

UNIT 5 SEMICONDUCTOR AS DEVICES AND RECENT ADVANCES 9

Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductor junctions - Homo and hetero Junctions. Active and passive optoelectronic devices: performance and response enhancement (photo processes)**.**

TEXT BOOK:

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014 **(for units 1 and 2)**

2. G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 5)

REFERENCES:

1. Kevin F Brennan, "The Physics of Semiconductors", Cambridge Univ.Press 1999.
2. Peter Y Yu and Manuel Cardona, "Fundamentals of Semiconductors",Spriger, 1996.
3. Charles Kittel, "Introduction to Solid State Physics", 6th edition, Willey, 1991.
4. D.A. Neamen, "Semiconductor Physics and Devices", 3 rdEd.,Tata McGraw-Hill,2002.
5. Jasprit Singh, "Semiconductor Optoelectronics (Physics and Technology)", McGraw-Hill, 1995.
6. Online reference: Wikipedia, NPTEL

Course Outcome (COs)	
CO1	Understand the difference between metals, semiconductors and insulators
CO2	Understand the importance of doping to charge carrier density
CO3	Understand the electrical transport in semiconductors
CO4	Understand the difference between direct and indirect semiconductors
CO5	Understand the concept of semiconductor optoelectronic devices.
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	1	1					2	1	2	2		2	2	2
	CO2	3	1	1	3				2	1	2	2				
	CO3	3			2				3	2						
	CO4	3	1	1					2	1	2	2				
	CO5	1	2	3	2	2	2		2	1	1	2				
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18BSCH20	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Higher Secondary School Physical Science				
	Department:-Department of Chemistry				

COURSE OBJECTIVES:-

- To study the interrelationship between living organism and environment.
- To study of the nature and concepts of ecosystem.
- To learn about the integrated themes and biodiversity of an environment.
- To study of pollution control and waste management.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION **9**

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes. Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOK:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

Course Outcome (COs)	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3			2		3		3		1		3	2	2	2
	CO2	1	3	3		2		3		2		1	1			
	CO3		2				1			3	2					
	CO4	3		2	1			2				2	3			
	CO5		3		1		2				3					
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18ESCS101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Higher Secondary School Maths				
	Department:-Department of Computer Science & Engineering				

COURSE OBJECTIVES

To gain fundamental knowledge of algorithmic problem solving and python programming

MODULE 1 : ALGORITHMIC PROBLEM SOLVING **9**

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOK:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013

2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

Course Outcome (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	2	3	2	1		2	1	2		3	3	3
	CO2	3	3	2	2		2		1			2				
	CO3	2	2	1	3	2		1		1		2				
	CO4	2	2	1	2	3	2	1	2	1		2				
	CO5	2	3	1	2	2			2	2	1					
	CO6															
3	Category	Engineering Science (ES)														
4	Approval	47th Meeting of Academic Council														

U18ESME101	**ENGINEERING GRAPHICS & DESIGN (THEORY & LAB.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Department:-Department of Mechanical Engineering				

COURSE OBJECTIVES

To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice

SYLLABUS

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing;

Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)
Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE3:PROJECTIONS OF REGULAR SOLIDS&ISOMETRIC PROJECTIONS (10+3)
Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4: SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)
Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)
Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)
Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication

drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOK:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

Course Outcome (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
2	CO1	3			2			3						2	2	2
	CO2	3	3	1		3	2									
	CO3			3												
	CO4											3				
	CO5	3						1								
	CO6															
3	Category	Engineering Science (ES)														
4	Approval	47th Meeting of Academic Council														

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – **Problem Solving And Python Programmingg**				
	Department:-Department of Computer Science & Engineering				

COURSE OBJECTIVES:
To enhance the practical knowledge on writing programs using Python

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search

6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1 Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

Course Outcome (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	2	3	3	2	2	2	2		2		3	3	3
	CO2	3	3	1	3	3	2	1	2	2	2	2				
	CO3	3	3	2	2	2	2		2	2	2	2				
	CO4	3	2	3	3	3	2	2	2	2	1					
	CO5	3	3	2	3	2	2		2	2	1	2				
	CO6															
3	Category	Engineering Science (ES)														
4	Approval	47th Meeting of Academic Council														

U18BSMA301	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
	Total Contact periods : 60	**3**	**1**	**0**	**4**
	Prerequisite – Engineering Mathematics I & II				
	Department:-Department of Mathematics				

COURSE OBJECTIVES:

- Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.

- Learn techniques of solving the standard types of first order and second order partial differential equations.
- Learn solving wave and heat equation using Fourier series.
  Understand the problems using Fourier transform and their properties. Understand the problems using Z - transform and their properties.

UNIT I FOURIER SERIES (9+3)

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORMS (9+3)

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORMS AND DIFFERENCE EQUATIONS (9+3)

Z – Transform – Elementary properties – Inverse Z – Transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – Transform.

TEXT BOOK:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.

REFERENCES:

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
3. Venkataraman. M. K. "Engineering Mathematics Volume III" , 13th Edition National Publishing Company, Chennai, 1998.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.
5. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
6. Shanmugam,T.N.:http:.www.annauniv.edu/shan/trans.h

Course Outcome (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.

CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications.
CO5	Apply the basics of Z – Transform in its applicability to discretely varying functions, gained the skill of formulate certain problems in terms of difference equations and solve them using the Z – Transform techniques.
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3		2	2						1		2	2	2
	CO2	3		1		3		2	2				1			
	CO3	3			3	2			2		1					
	CO4	3			2					1						
	CO5	3					2						1			
	CO6															
3	Category	Basic Science (BS)														
4	Approval	47th Meeting of Academic Council														

U18PCEC301	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours –60	3	1	0	4
	Prerequisite – Engineering Mathematics-II				
	Department:-Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:

This course trains students for an intermediate level of fluency with signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing (including audio, image and video processing), communication theory, and system theory, control and robotics.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9+3

Continuous time signals (CT signals), discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and aperiodic, random singals, CT systems and DT systems, Classification of systems - Linear Time invariant Systems.

UNIT II ANALYSIS OF C.T. SINGALS 9+3

Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in Signal Analysis.

UNIT III LTI-CT SYSTEMS 9+3

Differential equation, Block diagram representation, Impulse response, Convolution integral, Frequency response, Fourier Methods and Laplace transforms in analysis, State equations and Matrix.

UNIT IV ANALYSIS OF D.T. SIGNALS 9+3

Spectrum of D.T. signals, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Properties of Z-transform in signal analysis.

UNIT V LTI-DT SYSTEMS 9+3

Difference equations, Block diagram representation, Impulse response, Convolution SUM, Frequency response, FFT and Z-transform analysis, State variable equation and Matrix.

TEXT BOOK:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 20076.
4. www.nptel.ac.in

Course Outcome (COs)	
CO1	To Understand different types of signals-continuous and discrete, odd and even, periodic and aperiodic etc. Be able to classify systems based on their properties
CO2	To familiarize the concepts of transform based continuous time signals
CO3	Analyze continuous time systems by using appropriate mathematical tools
CO4	Analyze sampling process and sampling of discrete time signals.
CO5	Analyze discrete time signals by using appropriate mathematical tools
CO6	Determine Fourier transforms for discrete-time system, and understand how to interpret and plot Fourier transform magnitude and phase functions

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3		3		3	3	3
	CO2	3	3	3	3	3			3	3	2	3				
	CO3	3	3	3	3	2			3	3	2					
	CO4	3			3	2			2				2			
	CO5	3	3	3	3	3			3	3		3				
	CO6	3	3	3	3	3			3	3	2	3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC302	**DIGITAL SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Basic Electronics Engineering				
	Department:-Department of Electronics And Communication Engineering.				

COURSE OBJECTIVES:

To manipulate across various number system and to compute binary arithmetic operations.
To understand the design of combinational and sequential circuits using gates.
To know the concept of memories and programmable logic devices
To learn the design of asynchronous and synchronous sequential circuits

UNIT I BASIC CONCEPTS, BOOLEAN ALGEBRA AND LOGIC GATES 9

Number systems - Binary, Octal, Decimal, Hexadecimal, conversion from one to another, complement arithmetic, Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables. Quine-McCluskey method of minimization

UNIT II COMBINATIONAL CIRCUITS 9

Problem formulation and design of combinational circuits, Half Adder, Full adder, Half Subtractor, Full Subtractor, Carry Look Ahead adder, BCD adder, Fast adder, Serial adder/subtractor, Binary Multiplier, Binary Divider, Encoder ,Decoder, Mux / Demux, Code-converters, Parity Generators, Comparators.

UNIT III SEQUENTIAL CIRCUIT 9

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

UNIT IV LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES 9

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

UNIT V VLSI DESIGN FLOW 9

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

TEXT BOOK:

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. William I. Fletcher, " An Engineering Approach to Digital Design ", Prentice-Hall of India, 1980.

REFERENCES:

1. John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning,2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
6. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition,2006.

7 http://www.electrical4u.com/digital-electronics

Course Outcome (COs)	
CO1	Recall the different number systems and demonstrate the simplification of Boolean expressions using Boolean algebra & K-Map method.
CO2	Analyze the Combinational building blocks.
CO3	Analyze the sequential building blocks.
CO4	To Learn about Logic families.
CO5	To gain knowledge about semiconductor memories

CO6	To learn about VLSI design flow and the importance of VHDL														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3		3	1	2			2				3	3	3
	CO2	2	3	2	3		2				2	3				
	CO3	3	3								2	3				
	CO4	3														
	CO5	2	3	2	3		2			2						
	CO6	3	3	2	3					2	3	3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC303	**ELECTRONIC DEVICES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basic Electrical and Electronics Engineering				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES:

To acquaint the students with the construction, theory and operation of the basic semiconductor devices such as PN junction diode, Bipolar and Field effect Transistors.
To know the applications of the basic semiconductor devices

UNIT I SEMICONDUCTOR DEVICES 9

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Zener Diode and its characteristics ,Voltage Regulation using Zener Diode

UNIT II RECTIFIERS AND FILTERS 9

The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π- Section Filters, Comparison of Filters

UNIT III TRANSISTOR BIASING AND STABILIZATION 9

Operating Point, The DC and AC Load lines, Need for Biasing, Fixed Bias, Collector Feedback Bias, Emitter Feedback Bias, Collector - Emitter Feedback Bias, Voltage Divider Bias, Bias Stability, Stabilization Factors, Bias Compensation using Diodes and Transistors, Thermal Runaway, Thermal Stability

UNIT IV BIPOLAR JUNCTION TRANSISTOR AND UJT 9

BJT Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, BJT as an Amplifier ,BJT Hybrid Model, Determination of h-parameters from Transistor Characteristics, Comparison of CB, CE, and CC Amplifier Configurations, UJT and Characteristics.

UNIT V FIELD EFFECT TRANSISTOR AND FET AMPLIFIERS 9

Field Effect Transistor: The Junction Field Effect Transistor (Construction, principle of operation, symbol) – Pinch-off Voltage - Volt-Ampere characteristics, The JFET Small Signal

Model, **MOSFET** (Construction, principle of operation, symbol), MOSFET Characteristics in Enhancement and Depletion modes.

TEXT BOOK:

1. Millman's Electronic Devices and Circuits – J. Millman, C.Halkias, and Satyabrata Jit, 2 Ed., 1998, TMH.
2. Electronic Devices and Circuits – David A. Bell, 5 Ed, Oxford.

REFERENCES:

1. Integrated Electronics – J. Millman and Christos C. Halkias, 1991 Ed., 2008, TMH.
2. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, 9 Ed., 2006, PEI/PHI.
3. Electronic Devices and Circuits – B. P. Singh, Rekha Singh, Pearson, 2 Ed, 2013.
4. Electronic Devices and Circuits - K. Lal Kishore, 2 Ed., 2005, BSP.
5. Electronic Devices and Circuits – Anil K. Maini, Varsha Agarwal, 1 Ed., 2009, Wiley India
6. www.electronics-notes.com/

Course Outcome (COs)	
CO1	To understand and analyze the different types of diodes, operation and its characteristics
CO2	To analyze the rectifier circuits and various filters
CO3	To study and understand the BJT and FET.
CO4	To study and understand the various biasing methods of BJT.
CO5	To understand various stabilization techniques of BJT.
CO6	To understand operation and characteristics of FET amplifiers

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	2	1	2			2	1		2		3	3	3
	CO2	3	2	2	1	2			2	2		2				
	CO3	2	3	2	2	3			3	2		1				
	CO4	2		1		2			2	2		2				
	CO5	2	1	1	1	2			3	2		2				
	CO6	3	2	2	1	2			3	1		1				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC304	**NETWORK THEORY**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Engineering Mathematics-II & Basic Electrical and Electronics Engineering				
	Department:-Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:

- To analyze concepts of symmetrical and asymmetrical networks.
- To realize the basic Networks and Design the various filters.
- To design Attenuators and Equalizers which are employed in the communications system

- To study the response of the RLC circuits and construct the network.
- To realize the RL and RC networks by synthesis

UNIT I BASIC CIRCUITS ANALYSIS AND NETWORK THEOREMS 9

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactance's, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Thallogen's theorem as applied to AC circuits.

UNIT II FOURIER TRANSFORMATIONS 9

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

UNIT III LAPLACE TRANSFORM TECHNIQUES 9

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

UNIT IV TRANSIENT ANALYSIS 9

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of admittance function, their properties, sinusoidal response from pole-zero locations,

UNIT V FILTER DESIGN TECHNIQUES 9

convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters

TEXT BOOK:

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000

REFERENCES:

1. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
2 A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education
3. www.nptel.ac.in

Course Outcome (COs)	
CO1	Develop the capacity to analyze electrical circuits, apply the circuit theorems in real time.
CO2	Obtain the various network parameters for the given two port networks.
CO3	Design asymmetric, symmetric, attenuator and equalizer networks.
CO4	Determine the parameters for the design of various filters
CO5	Estimate Step and Impulse response of RL and RC networks.
CO6	Synthesize RL and RC networks.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3

2	CO1	3	3	3	3	3			3	3		3	3	3	3	3
	CO2	3	3	3	3	3			3	3	2	3	3			
	CO3	3	3	3	3	2			3	3	2		3			
	CO4	3			3	2			2				3			
	CO5	3	3	3	3	3			3	3		3	3			
	CO6	3	3	3	3	3			3	3	2	3	3			
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18HSEC301	PROFESSIONAL ETHICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Department:-Dept of Management Studies				

COURSE OBJECTIVES:

To teach the philosophy of Life, personal value, social value, mind cultural value and personal health

To teach professional ethical values, codes of ethics, responsibilities, safety, rights and related global issues

UNIT I PROFESSIONAL ETHICS 9

Ethics in workplace- Formulation of Ethics- Managerial Ethics- Managing Ethical Behavior- codes of Ethics – Encouraging Ethical Behavior- Social Responsibility-Spirituality.

UNIT II SOCIAL VALUES 9

Family - Peace in Family, Society, The Law of Life Brotherhood - The Pride of Womanhood – Five responsibilities/duties of Man : - a) to himself, b) to his family, c) to his environment, d) to his society, e) to the Universe in his lives, Thriftiness (Thrift)/Economics. Health - Education - Governance - People's Responsibility / duties of the community, World peace.

UNIT III LIFE BODY RELATION & CULTURE 9

Mind Culture - Life and Mind - Bio - magnetism, Universal Magnetism (God –Realization and Self Realization) - Genetic Centre – Thought Action – Short term Memory – Expansiveness – Thought – Waves, Channelizing the Mind, Stages - Meditation, Spiritual Value. Structure of the body - the three forces of the body- life body relation, natural causes and unnatural causes for diseases, Methods in Curing diseases

UNIT IV SOCIAL RESPONSIBILITIES FOR SAFETY FOR ENGINEERS'S 9

Engineering as Experimentation – Engineer as Responsible Experimenters – Codes of Ethics – The Challenger, case study. Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl case studies.

UNIT V RIGHTS AND GLOBAL ISSUES FOR ENGINEERS'S 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Whistle Blowing – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development –Engineers as Managers – Consulting Engineers – Engineers as Expert Eye Witnesses and Advisors – Moral Leadership.

TEXT BOOK:

1. R S Nagaarazan, Textbook On Professional Ethics And Human Values, New Age International Publishers, 2006.
2. Mike W Martin and Roland Schinzinger, Ethics In Engineering, Tata Mcgraw Hill, Newyork 2005

REFERENCES:

1. Philosophy of Universal Magnetism (Bio - magnetism, Universal Magnetism) The World Community Service Centre Vethathiri Publications.
2. Thirukkural with English Translation of Rev. Dr. G.U. Pope, Uma Publication, 156, Serfoji Nagar, Medical College Road,Thanjavur 613 004.
3. Value Education for Health, Happiness and Harmony, The World Community Service, Centre Vethathiri Publications.
4. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 2004.
5. www.waceinc.org/philly2011/conference.../KARSTE~1.PDF

Course Outcome (COs)	
CO1	To learn about philosophy of Life and Individual qualities
CO2	To learn and practice social values and responsibilities
CO3	To learn and practice mind culture, forces acting on the body and causes of diseases and their curing
CO4	To learn more of Engineer as Responsible Experimenter.
CO5	To learn more of Risk and Safety assessment with case studies.
CO6	To learn more of responsibilities and rights as Professional and facing Global Challenges

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1				1		3		2	2			3	2	2	2
	CO2				2		3		3	3			3			
	CO3						3		3	3			3			
	CO4						3		2	2			3			
	CO5						3		2	2			3			
	CO6						3		2	2			3			
3	Category	Humanities ans Social Science (HS)														
4	Approval	48th Meeting of Academic Council														

U18PCEC3L1	**ELECTRONIC DEVICES LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	0	0	2	1
	Prerequisite – Basic Electrical and Electronics Engineering Practices Lab				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES:

To enhance the practical knowledge on Electronic Devices through Experiments.

LIST OF EXPERIMENTS FOR ELECTRONIC DEVICES LAB

1. Study of CRO
2. V-I characteristics of PN junction diode

3. V-I characteristics of Zener diode and Zener regulator Characteristics
4. Half-wave rectifier with and without filter
5. Full-wave rectifier with and without filter
6. BJT input/output characteristics (CE configuration)
7. UJT input/output characteristics
8. Comparison of performance of self bias and fixed bias circuits
9. Transfer characteristics of JFET
10. Transfer characteristics of MOSFET
11. Simulation experiments using Pspice or Multisim.

Experiments beyond the syllabus should be conducted

Course Outcome (COs)	
CO1	To analyze the characteristics of PN junction and Zener Diode
CO2	To analyze Rectifier with and without filter
CO3	To analyze the characteristics of BJT and UJT
CO4	To compare the performance of self bias and fixed bias circuits
CO5	To analyze the characteristics of JFET and MOSFET
CO6	To provide the capability to use simulation tools for performing various analysis of semiconductor devices

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	2	1	1			2	2		1		3	3	3
	CO2	2	1	1	2	3			2	1		2				
	CO3	2	2	1	2	3			2	2		1				
	CO4	2	1	1		3			3	2		2				
	CO5	3	1	1	2	3			3	2		2				
	CO6	2	2	3	2	1			2	1		2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC3L2	**DIGITAL SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	0	0	2	1
	Prerequisite –Basic Electronics Engineering Lab				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES:

To know the concepts of Combinational circuits.
To understand the concepts of flip-flops, registers and counters

List of Experiments

1. Study of logic gates.
2. Design and implementation of adders and subtractors using logic gates.
3. Design and implementation of encoder and decoder using logic gates.
4. Design and implementation of multiplexer and demultiplexer using logic gates .
5. Design and implementation of 2-bit magnitude comparator using logic gates,
6. Design and implementation of 16-bit odd/even parity checker.
7. Design and implementation of Flipflops using logic gates.

8. Design and implementation of code converters using logic gates.
9. Design and implementation of counters.
10. Design and Implementation of shift registers.

Experiments beyond the syllabus should be conducted.

Course Outcome (COs)	
CO1	Learn the basics of gates.
CO2	Construct basic combinational circuits and verify their functionalities
CO3	Apply the design procedures to design basic sequential circuits
CO4	Learn about counters
CO5	Learn about Shift registers
CO6	To understand the basic digital circuits and to verify their operation

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3		3							2		3	3	3
	CO2	3	3	3	3	3			2	2	3	3				
	CO3	3	3	3	3	3			2	2	3	3				
	CO4	2	3	3	3					2	3	3				
	CO5	2	3		2							3				
	CO6	3	3	3	2	3			2	3	3	2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCAB305 LEARNING AN ART FORM

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like Chaiti, Hori, Kajri and Birha.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn

and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306 INTANGIBLE CULTURAL HERITAGE (FESTIVALS, FOOD WAYS, LOCAL GAMES)

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

- To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;
- To study and document the prevalent social practices and beliefs regarding traditional foods;
- To study and document the feasts on religious and social occasions of different communities;
- To identify and document the food items consumed by different communities and determine their nutritional values;
- To conduct chemical analysis of food ingredients;
- To identify and document the kitchen generated health ingredients used by different communities;
- To find out the uses of leftover food stuff of different communities;
- To develop hygienic food chart for people ailing and suffering from different metabolic disorders;
- To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

U18BSMA404	**PROBABILITY AND STOCHASTIC PROCESSES**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – Basic knowledge of probability				
	Department:- Department of Mathematics				

COURSE OBJECTIVES

- The objective of this course is to introduce the students to the idea of random variables, distribution and random process, and an important mathematical tool in signal processing.
- An ability to design and analyze an Electronic circuits in Engineering as well as to formulate coding to interpret data.
- An ability to use the techniques, skills, and modern tools in science and engineering environment

UNIT I PROBABILITY THEORY (9+3) Hrs

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and Sampling models.

UNIT II RANDOM VARIABLES (9+3) Hrs

Discrete random variables, probability mass function, probability distribution function, and standard distributions; Continuous random variables, probability density function, probability distribution function, and standard distributions.

UNIT III TWO DIMENSIONAL RANDOM VARIABLES (9+3) Hrs

Joint distributions, Marginal and conditional distributions-covariance- correlation and regression: properties and problems- rank correlation; Transformation of a random variable.

UNIT IV APPLICATION OF TWO DIMENSIONAL RANDOM VARIABLES (9+3)Hrs

Random sequences and modes of convergence (everywhere, almost everywhere probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

UNIT V RANDOM PROCESS AND SPECTRAL DENSITY (9+3)Hrs

Random process, Stationary processes. Mean and covariance functions, Markov, Ergodicity, Power spectral density, Transmission of random process through LTI.

TEXT BOOK:

1. S.C.Gupta & V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003.
2. Peebles Jr., "Probability, Random Variables and Random Signal Principles", McGraw Hill Publishers, (1987).

REFERENCES:

1. A. Papoulis and S. Unni Krishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill 4.
2. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
4. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press

Course Outcome (COs)	
CO1	Apply concepts of Probability to solve problems in Electronic Engineering.
CO2	Make students understand Discrete and Continuous Random variables, Random Processes and their applications in Electronic Transmissions
CO3	Find the trend information from discrete data set through numerical differentiation and summary information through random process
CO4	Understand propagation of random signals in LTI systems
CO5	Find functional relationship between random inputs and outputs with the use of Random Process Techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3				2		1			1	2		2	2	2
	CO2	3		3	1	2	1		2				2			
	CO3	3				2				1		2				
	CO4	3	2			2				1			1			
	CO5	3		3		2				2	1	2				
	CO6															
3	Category	Humanities and Social Scienc(HS)														
4	Approval	47Th Meeting of Academic Council														

U18PCEC401	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital Electronics				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES

The student should be made to:

- Understand analog and digital communication techniques.
- Learn data and pulse communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

UNIT I ANALOG COMMUNICATION 9

Noise: Source of Noise - External Noise- Internal Noise - Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM –FM – PM).

UNIT II DIGITAL COMMUNICATION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK– FSK – PSK – QAM).

UNIT III DATA AND PULSE COMMUNICATION 9

Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System.

UNIT IV SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon Fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.

UNIT V MULTI-USER RADIO COMMUNICATION 9

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TEXT BOOK:

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007

3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford University Press, 2007.
5. Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2002.rd
6. Martin S.Roden, “Analog and Digital Communication System”, 3 Edition, Prentice Hall of India,2002.
7. B.Sklar, “Digital Communication Fundamentals and Applications” 2 Edition Pearson Education 2007.
8. www.nptel.ac.in

Course Outcome (COs)	
CO1	Apply analog and digital communication techniques.
CO2	Use data and pulse communication techniques.
CO3	Analyze Source and Error control coding.
CO4	Gain knowledge on multi-user radio communication.
CO5	To understand the various applications of coding
CO6	Discuss the various types of systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
2	CO1	3	3	3	2	1			1	2	1	1		3	3	3
	CO2	1	3	2	1	1			2	2	2	2	2			
	CO3	3	3	1	2	2			1	2	2	1				
	CO4	1	2	2	1	2			2	1	1	1				
	CO5	1	2	3	3	3			2	2	2	3	2			
	CO6	3	3	2	3	1			3	2	1	2	1			
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC402	**ANALOG CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic electrical and electronics, Electronic Devices				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES
Learn about biasing of BJTs and various transistor models
To teach the fundamentals of amplifiers, types of amplifiers, gain margin
Study Oscillators and characteristics.
Study OP AMP and its applications
To introduce the fundamentals of DAC and ADC

UNIT I INTRODUCTION 9

Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small

signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

UNIT II HIGH FREQUENCY TRANSISTOR MODELS AND POWER AMPLIFIERS 9

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

UNIT III OSCILLATORS 9

Review of the basic concept, Barkhuizen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitts, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.

UNIT IV OPEARTIONAL AMPLIFIER AND ITS APPLICATIONS 9

OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

UNIT V DIGITAL TO ANALOG CONVERTERS (DAC) AND ANALOG TO DIGITAL CONVERTERS 9

Digital -to-analog converters Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

TEXT BOOKS

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.

REFERENCE BOOKS

1. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
2. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11Publishing, Edition IV
3. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition
4. www.nptel.ac.in

Course Outcome (COs)	
CO1	Understand the characteristics of diodes and transistors.
CO2	Design and analyze various rectifier and amplifier circuits
CO3	Design sinusoidal and non-sinusoidal oscillators.

CO4	Understand the functioning of OP-AMP and design OP-AMP based circuits
CO5	Design ADC and DAC.
CO6	Understand the applications of OP – AMP and special function IC's

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3	3	3		3	3	3
	CO2	3	2	3	3	2			2		3	2				
	CO3	3	3	2	2	2			2	2		2				
	CO4	3	3	3	3	3			2	3	3	3				
	CO5	2	2	3	3											
	CO6	3	3	3	2	3			3	3	3	3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC403	MICROCONTROLLERS	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – Digital System Design				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES

The student should be made to:

The objective of this course is to become familiar with the architecture and the instruction set of an Intel microcontroller

Assembly language programming will be studied as well as the design of various types of digital and analog interfaces

Understand the architecture of 8051

UNIT 1 MICROPROCESSORS AND MICROCONTROLLER INTRODUCTION 9

Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture, Computer software. The 8051 Architecture: Introduction, Architecture of 8051, Pin diagram of 8051, Memory organization, External Memory interfacing, Stacks.

UNIT II ADDRESSING MODES INSTRUCTION SET 9

Addressing Modes: Introduction, Instruction syntax, Data types, Subroutines, Addressing modes: Immediate addressing, Register addressing, Direct addressing, Indirect addressing, relative addressing, Absolute addressing, Long addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. Instruction set: Instruction timings, 8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction.

UNIT III 8051 PROGRAMMING 9

Assembler directives, Assembly language programs and Time delay calculations.

UNIT IV 8051 INTERFACING AND APPLICATIONS 9

Basics of I/O concepts, I/O Port Operation, Interfacing 8051 to LCD, Keyboard, parallel and serial ADC, DAC, Stepper motor interfacing and DC motor interfacing and programming.

UNIT V 8051 INTERRUPTS AND TIMERS/COUNTERS 9

Basics of interrupts, 8051 interrupt structure, Timers and Counters, 8051 timers/counters, programming 8051 timers in assembly and C .

TEXT BOOK:

1. The 8051 Microcontroller and Embedded Systems : Using Assembly and C" by Muhammad Ali Mazidi
2. "Microprocessors and Microcontrollers : Architecture, Programming and Interfacing Using 8085, 8086 and 8051" by Soumitra Kumar Mandal.

REFERENCES:

1. "Microprocessors And Microcontrollers" by A Nagoor Kani
2. "Microprocessors And Microcontrollers : Architecture, Programming and System Design 8085, 8086, 8051, 8096" by KRISHNA KANT
3. www.nptel.ac.in

Course Outcome (COs)	
CO1	Independently design and implement an embedded system based on an eight-bit microcontroller, taking into account energy conservation and possible software errors,
CO2	Program a microcontroller using C, including hardware configuration and interrupt service routines,
CO3	Manage parallel processes with different priority and real time constraints without the aid of an operating system,
CO4	Select data types and algorithms suitable for the architecture and instruction set of a given microcontroller
CO5	Give a detailed description of limitations of the chosen system design
CO6	Debug a microcontroller application using different tools.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			1			2		3	3	3
	CO2	3	2	2	2	3			2			2				
	CO3	3	1	1	2	2						2				
	CO4	2	1	2	1	2				1		2				
	CO5	2	2	1	2	1			1	2		2				
	CO6	3	3	2	2	2			2	1		3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC404	**ELECTROMAGNETIC WAVES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Transforms and Partial Differential equation				
	Department:- Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

- To impart knowledge on the basics of static electric and magnetic field and the associated laws.
- To give insight into the propagation of EM waves and also to introduce the methods in computational electro magnetics.
- To make students have depth understanding of antennas, electronic devices, waveguides is possible

UNIT I STATIC ELECTRIC FIELD 9

Vector Algebra, Coordinate Systems, Vector differential operator, Gradient, Divergence, Curl, Divergence theorem, Stokes theorem, Coulombs law, Electric field intensity, Point, Line, Surface and Volume charge distributions, Electric flux density, Gauss law and its applications, Gauss divergence theorem, Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT II CONDUCTORS AND DI ELECTRICS 9

Conductors and dielectrics in Static Electric Field, Current and current density, Continuity equation, Polarization, Boundary conditions, Method of images, Resistance of a conductor, Capacitance, Parallel plate, Coaxial and Spherical capacitors, Boundary conditions for perfect dielectric materials, Poisson's equation, Laplace's equation, Solution of Laplace equation, Application of Poisson's and Laplace's equations.

UNIT III STATIC MAGNETIC FIELDS 9

Biot-Savart Law, Magnetic field Intensity, Estimation of Magnetic field Intensity for straight and circular conductors, Ampere's Circuital Law, Point form of Ampere's Circuital Law, Stokes theorem, Magnetic flux and magnetic flux density, The Scalar and Vector Magnetic potentials, Derivation of Steady magnetic field Laws.

UNIT IV MAGNETIC FORCES AND MATERIALS 9

Force on a moving charge, Force on a differential current element, Force between current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions involving magnetic fields, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance, Basic expressions for self and mutual inductances, Inductance evaluation for solenoid, toroid, coaxial cables and transmission lines, Energy stored in Magnetic fields.

UNIT V TIME VARYING FIELDS AND MAXWELL'S EQUATIONS 9

Fundamental relations for Electrostatic and Magnetostatics fields, Faraday's law for Electromagnetic induction, Transformers, Motional Electromotive forces, Differential form of Maxwell's equations, Integral form of Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and their solutions, Poynting's theorem, Time harmonic fields, Electromagnetic Spectrum.

TEXT BOOK:

1. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems

REFERENCES:

1. Karl F. Warnick: "Numerical Methods for Engineering: An Introduction Using MATLAB and Computational Electromagnetics Examples," SciTech Publishing, 2010
2. Matthew N.O. Sadiku: "Numerical Techniques in Electromagnetics with MATLAB," Third Edition, CRC Press

3. A. F. Peterson, S. L. Ray, and R. Mittra, "Computational Methods for Electromagnetics" (IEEE Press, New York, 1998).
4. www.Wiley.com

Course Outcome (COs)	
CO1	Analyze field potentials due to static changes and static electric fields
CO2	Explain how materials affect electric fields
CO3	To analyze about static magnetic field.
CO4	Explain how materials affect magnetic fields
CO5	Analyze the relation between the fields under time varying situations
CO6	Discuss the principles of propagation of uniform plane waves

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3		3		3	3	3
	CO2	3	3	3	3	3			3	3	3	3				
	CO3	3	3	2	2	3					3					
	CO4	3	2	3	2											
	CO5	3	3	3	3				3	3	2	3				
	CO6	3	2	2		3			2	2						
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18ESCS401	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Fundamentals of Computing and Programming				
	Department:- Dept of Information Technology				

COURSE OBJECTIVES

- To provide a brief, hands-on overview of object-oriented analysis in software process
- To discuss Case studies-based project specifications to develop object-oriented models and identify implementation strategies.
- To demonstrate and apply basic object-oriented techniques to create and modify object-oriented analysis and design models.
- To understand and apply testing techniques for object-oriented software.

UNIT I DATA ABSTRACTION & OVERLOADING 9

Overview of C++–Structures–Class Scope and Accessing Class Members –Reference Variables–Initialization–Constructors–Destructors–MemberFunctionsandClasses– Friend Function – Dynamic Memory Allocation – Static Class Members –Overloading: Function overloading and Operator Overloading.

UNIT II INHERITANCE&POLYMORPHISM 9

Base Classes and Derived Classes–Protected Members–Overriding –Public, Protected and Private Inheritance –Constructors and Destructors in derived Classes–Implicit Derived– Class

Object to Base–Class Object Conversion–Virtual functions–This Pointer–Abstract Base Classes and Concrete Classes– Virtual Destructors– Dynamic Binding.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs)–List ADT–array-based implementation– linked list implementation– singly linked lists–Polynomial Manipulation-Stack ADT – Queue ADT

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees–Binary Trees –Binary tree representation and traversals–The Search Tree ADT– Graph and its representations–Graph Traversals–Breadth-first search–Depth-first search– Bi-connectivity**.**

UNIT V SORTING AND SEARCHING 9

Sorting algorithms: Insertion Sort-Quick sort –Mergesor-Searching: Linear search –Binary S

TEXT BOOK:

1. Deitel and Deitel, - C++, How to Program, Fifth Edition, Pearson Education, 2005.
2. Bhushan Trivedi, - Programming with ANSIC++ ,A Step-By-Step approach Oxford University Press, 2010.

REFERENCES:

1. Goodrich, Michael T., Roberto Tamassia, David Mount, ―Data Structures and Algorithms in C++‖, 7th Edition, Wiley. 2004
2. Thomas H. Cormen, CharlesE. Leiserson, RonaldL. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
3. Bjarne Stroustrup, - The C++ProgrammingLanguage‖,3rd Edition, Pearson Education,2007
4. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, ―Fundamentals of Data Structures In C++‖, Galgotia Publications, 2007.
5. http://users.cis.fiu.edu/~weiss/
6. www.youtube.com/watch?

Course Outcome (COs)	
CO1	Develop solutions to a given problems using class object concepts.
CO2	Illustrate overloading, inheritance and polymorphism concepts with example
CO3	Explain the basic data structures and its operations
CO4	Make use of basic data structures to solve problems
CO5	To develop programs using C++ which forms the basic for advanced programming
CO6	Outline various searching and sorting algorithms

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1		3				2							3	3	3
	CO2	2			3	2				2						
	CO3		2									1				
	CO4	1														
	CO5			1	2						2					
	CO6															
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCTH502	UNIVERSAL HUMAN VALUES	L	T	P	C
	Total Contact Periods – 30	2	0	0	0
	Prerequisite –nil				
	Department:-AICTE				

Course Objective

The objective of the course is four-fold:

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcome

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be mad

U18HSBA401	ORGANIZATIONAL BEHAVIOR	L	T	P	C
	Total No. of contact hours: 45	3	0	0	3
	Pre-requisite: NIL				
	Department:-Dept of Management Studies				

COURSE OBJECTIVES

Understanding the basic approaches in organization
Knowledge on theories of Personality
Clear sight on the Decision Making in Groups
Analyze the behavior of individuals and groups in organizations in terms of the key factors that influence organizational behavior. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behavior.

UNIT I **9**

Organizational Behavior – Definition, need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9**

Individual behavior – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behavior.

UNIT III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behavior and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES:

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizational Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

Course Outcome (COs)	
CO1	Familiarity with the knowledge of Frame work of Organizational Behavior
CO2	Knowledge of the Interpersonal perception
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Fmiliarity with the knowledge of types of Conflicts

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3					3					3		1	1	1
	CO2		3		2					3						
	CO3	2							2		3					
	CO4			2	3							3				
	CO5							2								
	CO6															
3	Category	Humanities and Social Science including Management Courses (HS)														
4	Approval	48th Meeting of Academic Council														

U18PCEC4L1	**ANALOG AND DIGITAL COMMUNICATION LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	1
	Prerequisite – Digital Electronics				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES

- Understand analog and digital communication techniques.
- Learn data and pulse communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

List of Experiments:

1. Generation of noise and observations of its effect on a sinusoidal signal
2. Generation of AM signals
3. Demodulation of AM signals
4. Frequency modulation
5. Introduction to phase locked loop
6. FM Demodulators
7. Digital Modulation: FSK
8. Pre-emphasis & De-emphasis
9. Pulse code modulation
10. MATLAB basic for communication system design

11. Introduction to amplitude modulation (SIMULINK implementation)
12. Introduction to amplitude modulation (MATLAB implementation)

Course Outcome (COs)	
CO1	Apply analog and digital communication techniques.
CO2	Use data and pulse communication techniques.
CO3	Analyze Source and Error control coding.
CO4	Gain knowledge on multi-user radio communication.
CO5	To understand the various applications of coding
CO6	Discuss the various types of systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	2	3	2	2			2	2		1	1	3	3	3
	CO2	3	2		2	2			2	1		1				
	CO3	2	2	3	2	2			1	2		1				
	CO4	3	2	2	2	1			2	1		2	3			
	CO5	3	2	2	1	2			2	1		1				
	CO6	2	2	3	2	1			1	2		2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC4L2	**MICROCONTROLLER LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**0**	**0**	**2**	**1**
	Prerequisite – Digital System Design				
	Department:-Dept. of Electronics And Communication Engineering				

COURSE OBJECTIVES

The student should be made to:

- To introduce the basics of microcontroller and its applications.
- To provide in depth knowledge of 8051 ,PIC Microcontroller and Embedded-C programming
- To expertise working with Keil compiler and embedded C programming.
- To impart the I/O interfacing concepts for developing real time embedded systems.
- To encourage the students in building real time applications.

EMBEDDED C PROGRAMMING

LED Blinking using 8051 Microcontroller
Displaying Numbers on 7-Segment Display using 8051 Microcontroller
Timer/Counter Calculations and Program using 8051 Microcontroller
Serial Communication Calculations and Program using 8051 Microcontroller
Keypad Programming using 8051 Microcontroller
LCD Programming with 8051 Microcontroller
LED Blinking using PIC Microcontroller
Displaying Numbers on 7-Segment Display using PIC Microcontroller
Timer/Counter Calculations and Program using PIC Microcontroller
Serial Communication Calculations and Program using PIC Microcontroller

Keypad Programming using PIC Microcontroller
LCD Programming with PIC Microcontroller

MINI PROJECTS (any one)
Interfacing GPS with 8051 Microcontroller
Bidirectional Visitor Counter using 8051 Microcontroller
Water Level Controller using 8051 Microcontroller
Stepper Motor Control using 8051 Microcontroller
Password Based Door Locking System using 8051
Noncontact Digital Tachometer using 8051
Digital humidity sensor using PIC microcontroller

Course Outcome (COs)	
CO1	Familiarize with the embedded C programming using 8051.
CO2	Familiarize with 8051
CO3	Familiarize with the Keil µVision-3/4 and IAR Embedded Workbench tools.
CO4	Design circuits for various applications using microcontrollers.
CO5	Apply the concepts on real- time applications
CO6	To study about interfacing techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3
2	CO1	3	2	2	2	2			1		1	2		3	3	3
	CO2	3	2	2	2	2						2				
	CO3	3	2	2	2	3				1		2				
	CO4	2	3	3	2	2			1	1		2				
	CO5	2	3	3	1	2				1		2				
	CO6	2	3	3	1	2				1		2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC4L3	**ANALOG CIRCUIT LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite –Basic Electronics Lab				
	Department:-Dept of Electronics and communication engineering				

COURSE OBJECTIVES
The student should be made to:
Study the characteristic of CE, CB and CC Amplifier
Learn the frequency response of CS Amplifiers
Study the Transfer characteristic of differential amplifier
Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
Perform SPICE simulation of Electronic Circuits

List of Experiments

1. Half Wave and Full Wave Rectifiers, Filters, Power supplies
2. Frequency Response of CE, CB, CC and CS amplifiers
3. Darlington Amplifier
4. Differential Amplifiers- Transfer characteristic, CMRR Measurement
5. Cascode / Cascade amplifier
6. Class A and Class B Power Amplifiers
7. Determination of bandwidth of single stage and multistage amplifiers
8. Astable and Monostable multivibrators using transistors.
9. Single Tuned Amplifier
10. Double Tuned amplifiers.
11. Pspice Simulation of Common Emitter and Common Source amplifiers
12. Pspice Simulation of Clippers and Clampers

Course Outcome (COs)	
CO1	Differentiate cascade and cascade amplifier
CO2	Analyze the limitation in bandwidth of single stage and multi stage amplifier
CO3	Simulate amplifiers using Spice
CO4	Measure CMRR in differential amplifier
CO5	Analyze the characteristics of single tuned and double tuned amplifiers
CO6	Understand the characteristics of Multivibrators

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	2	2	2			1		1	2		3	3	3
	CO2	3	2	2	2	2						2				
	CO3	3	2	2	2	3				1		2				
	CO4	2	3	3	2	2			1	1		2				
	CO5	2	3	3	1	2				1		2				
	CO6	2	3	3	1	2				1		2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCAB407 LITERATURE, CINEMA AND MEDIA (WORKSHOP, READING MULTIPLE NEWS SOURCES, ANALYZE ADS)

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption.

Description.

Literature is perhaps as old as history or Aug be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not just the literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be

made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408 LITERATURE & MEDIA GROUP READING (SAAMUHIKVAACHAN) OF CLASSICS

This will make group to read one or two books during a semester.

Process: An hour Aug be fixed for a small group for a classic. Group sits, and each person reads aloud (if possible, with proper modulation) taking turns. This if done properly for an hour one Aug complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

U18PCEC501	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	**3**	**1**	**0**	**4**
	Prerequisite – Signals & Systems				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

To study about discrete time systems and to learn about FFT algorithms.

- -To study the design techniques for FIR and IIR digital filters.
- -To study the finite word length effects in signal processing.
- -To study the properties of random signal, Multirate digital signal processing and about QMF filters.

UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS 9+3

Sampling of Analogue signals – aliasing – standard discrete time signals – classification – discrete time systems – Linear time invariant stable casual discrete time systems – classification methods – linear and circular convolution – Overlap add and Save Methods-Difference

equation representation – DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms.

UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS 9+3

Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – pre-warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS 9+3

Symmetric and Antisymmetric FIR filters – Linear phase FIR filters – Design using Frequency sampling technique – Window design using Hamming, Hanning and Blackman Windows – Concept of optimum equiripple approximation – Realisation of FIR filters – Transversal, Linear phase and Polyphase realization structures.

UNIT IV FINITE WORD LENGTH EFFECTS 9+3

Quantization noise – derivation for quantization noise power – Fixed point and binary floating point number representations – Comparison – Overflow error – truncation error – coefficient quantization error – limit cycle oscillations- signal scaling – analytical model of sample and hold operations.

UNIT V SPECIAL TOPICS IN DSP 9+3

Discrete Random Signals- Mean, Variance, Co-variance and PSD – Periodiogram Computation – Principle of Multi rate DSP – decimation and Interpolation by integer factors – Time and frequency domain descriptions – Single, Multi stage, polyphase structures – QMF filters –Sub band Coding-Digital Signal Processor based applications

TEXT BOOK:

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing–Principles,
2. Algorithms & Applications", Fourth Edition, Pearson Education/Prentice Hall,2007.

REFERENCES:

1. Sanjit K.Mitra, "Digital Signal Processing–A Computer Based Approach", Tata McGraw Hill,
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson,2004.
3. www. ocw.mit.edu.

Course Outcome (COs)	
CO1	To apply DFT for the analysis of digital signals & systems.
CO2	To design FIR filters.
CO3	To design IIR filters.
CO4	To characterize finite Word length effect on filters.
CO5	To have a deep understanding on basics of digital signal processing which can be applied to communication systems.
CO6	To design the Multirate Filters.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3		3		3	3	3
	CO2	3	3	3	3	3			3	3	3	3				

	CO3	3	3	3	3	3			3	3	3	3				
	CO4	3	2		2											
	CO5	3	3	2	3				2	2	2					
	CO6	3	2	2	3	3			3	2						
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC502	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Semiconductor Physics				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES

To introduce the various types of transmission lines and to discuss the losses associated.
To give thorough understanding about impedance transformation and matching.
To impart knowledge on filter theories and waveguide theories

UNIT I TIME VARRYING FIELDS AND MAXWELL'S EQUTIONS 12

Motional Electromotive Force, General Expression for motional EMF, Faraday's Law of Induction, Displacement current, Maxwell's equation in the point or differential form, Maxwell's equations in Integral form, Maxwell's equations from Gauss's Law, Maxwell's equations and Boundary conditions, Poynting's theorem, Time harmonic (sinusoidal) fields, Maxwell's equations in phasor form.

UNIT II TRANSMISSION LINES 12

Need for Transmission Lines, Types of Transmission lines, Characterization in terms of primary and secondary constants, Characteristic impedance, General wave equation, Loss less propagation, Propagation constant, Wave reflection at discontinuities, Voltage standing wave ratio, Transmission line of finite length, The Smith Chart, Smith Chart calculations for lossy lines, Impedance matching by Quarter wave transformer, Single and double stub matching.

UNIT III THE UNIFORM PLANE WAVE 12

Wave propagation in free space, Wave propagation in dielectrics, Forward and Backward Travelling Wave, Poynting Theorem and Wave Power, Energy of the Radiated wave, Propagation in good conductors and good dielectrics, Skin effect, Wave polarization, Linearly, Elliptically and Circularly polarized waves

UNIT IV TRANSMISSION AND REFLECTION OF PLANE WAVES AT BOUNDARIES 12

Normal incidence of Uniform Plane waves: Conductor-Conductor interface, Dielectric-Dielectric interface, Dielectric-perfect Conductor interface, Dielectric-Conductor interface. Oblique incidence on a plane boundary for perpendicular polarization, Dielectric-Dielectric interface, Dielectric-Conductor interface.

UNIT V WAVE GUIDES AND CAVITY RESONATORS 12

General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

TEXT BOOK:

1. John D Ryder, "Networks Lines and Fields", Prentice Hall of India, New Delhi, 2005

REFERENCES:

1. William H Hayt and Jr JohnA Buck, "Engineering Electro Magnetic" Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
2. David KCheng, "Field and Wave Electromagnetics", Pearson Education Inc,Delhi,2004
3. John D Krausand Daniel A Fleisch,"Electromagnetics with Applications", McGraw Hill BookCo,2005
4. GSN Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, 2005
5. Bhag Singh Guru and HR Hiziroglu, "Electromagnetic Field Theory Fundamentals", Vikas Publishing House, New Delhi,2001.
6. N.Narayana Rao, " Elements of Engineering Electromagnetics" 6th Edition Prentice Hall, 2004
7. mit.edu/.../Microwave_Engineering_David_M_Pozar_4ed_Wiley_2011

Course Outcome (COs)	
CO1	Discuss the fundamental concepts of wave propagation in Transmission Lines and Wave Guides.
CO2	Analyze the line parameters and various losses in transmission lines.
CO3	Apply smith chart for line parameter and impedance calculations
CO4	Evaluate the characteristics of parallel plane and rectangular wave guides.
CO5	Evaluate the characteristics of Circular waveguides.
CO6	Evaluate the characteristics of resonators.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3				2							3	3	3
	CO2				3	2				2						
	CO3		2					1				1				
	CO4	1								1						
	CO5	3	3	1	2			2			2					
	CO6						3									
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC503	**ANTENNAS AND PROPAGATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	**3**	**1**	**0**	**4**
	Prerequisite – Transforms and Partial Differential equation				
	Department:- Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

Students will be introduced to antennas, their principle of operation
Antenna analysis and their applications.
Introduce the student to wave propagation over ground, through troposphere and ionosphere; diversity principles

UNIT I BASIC ANTENNA CONCEPTS 9+3

Radiation Patterns Beam solid angle, radiation intensity, Directivity, effective aperture, Antenna field zones, Polarization, impedance, cross field, Poynting vector. Friis Transmission

formula, Duality of Antennas, Antenna and Transmission line, Radiation from a dipole antenna, Antenna temperature System temperature**.**

UNIT II POINT SOURCES 9+3

Definition, Power patterns, Array of two-point sources – Pattern multiplication, Broad side array, End fire array, n-isotropic array, Evaluation of null directions and maxima, Amplitude distributions. Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array.

UNIT III SMALL ANTENNAS 9+3

Halfwave dipole antenna radiated fields of short dipole, small loop and helical Antenna, monofilar- multifilar helix. Radiation resistance, Directivity and Design Feature. Half wave dipole: radiated fields and other feature. Numerical tool for antenna analysis.

UNIT IV SPECIAL ANTENNAS: 9+3

Yagi uda Antenna, Tunstile antenna, Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, rhombic antenna, Horn antenna, Reflector antennas and their feed systems, Micro strip antenna, Impedance and antenna measurements.

UNIT V WAVE PROPOGATION 9+3

Ground wave propagation, Troposphere wave, wave- tilt of the surface wave, Ionosphere propagation – effective permittivity and Conductivity of ionized gas, Reflection – Refraction of waves from ionosphere, regular – irregular variation of Ionosphere, earth magnetic field, Faraday rotation, wave propagation in the Ionosphere. Duct propagation, Critical frequency and Space propagation,

TEXT BOOK:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antenna and Wave Propagation", Tata McGraw Hill, 4th Edition, 2010.
2. R.L.Yadava, "Antennas and Wave Propagation", PHI, 2011

REFERENCES:

1. Constantine A.Balanis, "Antenna Theory: Analysis and Design", Third Edition, John Wiley and Sons, 2012.
2. G.S.N. Raju, "Antennas and wave propagation", 1st Edition Pearson Education, 2012.
3. Robert S. Elliott, "Antenna Theory and Design", John Wiley and Sons, Revised Edition, 2007.
4. www.studynama.com/.../229-Antenna-wave-propagation-(AWP)-pdf-eb.

Course Outcome (COs)	
CO1	Define various antenna parameters
CO2	Analyze radiation patterns of antennas
CO3	Evaluate antennas for given specifications
CO4	Illustrate techniques for antenna parameter measurements
CO5	To understand the various applications of antennas.
CO6	Discuss radio wave propagation and Propagation effects in microwave systems, satellite, space, and radar links

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3

2	CO1	3	1	3	1	2			2	1		2	2	3	3	3
	CO2	3	2	2	1	2			2	2		2				
	CO3	2	2	3	2	2			2	1		2				
	CO4	2	2	2	1	2			3	1		2	3			
	CO5	2	1	2	1	2			2	1		2				
	CO6	3		1	2	2			2	1		1				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC504	**MICROWAVE THEORY AND TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite –Electromagnetic Waves				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES

Learn the concepts related to microwave transmission

Understand the principle and working of microwave devices

UNIT I INTRODUCTION TO MICROWAVES AND MATHEMATICAL MODEL OF MICROWAVE TRANSMISSION 9+3

History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT II ANALYSIS OF RF AND MICROWAVE TRANSMISSION LINES 9+3

Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

UNIT III PASSIVE AND ACTIVE MICROWAVE DEVICES 9+3

Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

UNIT IV MICROWAVE DESIGN PRINCIPLES 9+3

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas-Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

UNIT V MICROWAVE MEASUREMENTS AND SYSTEMS 9+3

Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal,. Measurement of Microwave antenna parameters.

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RF MEMS for microwave components, Microwave Imaging.

TEXT BOOK:

1. R.E. Collins, Microwave Circuits, McGraw Hill

REFERENCES:

1. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house
2. www.nptel.ac.in

Course Outcome (COs)	
CO1	To understand the concepts involved in microwave transmission and its applications
CO2	To analyse the microwave transmission lines
CO3	To learn the various active microwave devices.
CO4	To learn the various passive microwave devices.
CO5	To understand the various microwave design principles and the antenna parameters
CO6	To have a better understanding about microwave systems and its measurements

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	2		2		3	3	3
	CO2	2	3	2	2	2			2	2	2	2	2			
	CO3	3	3	3	2	2				2		2				
	CO4	3	3	3	2	2						2				
	CO5	3	3	3	2	2			2	3	3	3	2			
	CO6	3	3	3	2	2			2	3	3	3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCTH401	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Department:-AICTE				

COURSE OBJECTIVES:-

- Understand the premises informing the twin themes of liberty and freedom from a civil right perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in
- the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

UNIT I **4**

History of Making of the Indian Constitution**:** History Drafting Committee, (Composition & Working)

UNIT II **4**

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III **4**

Contours of Constitutional Rights &Duties: Fundamental Rights**,** Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV **4**

Organs of Governance: Parliament, Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT V **4**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Augor and role of Elected Representative CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT VI **4**

Election Commission**:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

SUGGESTED READING

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcome (COs)	
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4	Discuss the passage of the Hindu Code Bill of 1956.
CO5	Understand the concept of Administration
CO6	Understand the concept of Election commission
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3					3					3		1	1	1
	CO2		3		2					3						
	CO3	2							2		3					
	CO4			2	3							3				
	CO5							2								
	CO6	3					3					3				
3	Category	Mandatory Courses (MC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC5L1	**DIGITAL SIGNAL PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	**0**	**0**	**2**	**1**
	Prerequisite – Signals & Systems				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

- To implement Linear and Circular Convolution.
- To implement FIR and IIR filters.
- To study the architecture of DSP processor

LIST OF EXPERIMENTS FOR DIGITAL SIGNAL PROCESSING LABORATORY

1. Waveform generation
2. Sampling and its effect on aliasing
3. Linear and circular convolution
4. DFT computation
5. Fast Fourier transforms
6. FIR Filters Implementation
7. IIR Filters Implementation
8. Quantization Noise.
9. Multirate Signal Processing

10 DSP processor implementation.

Course Outcome (COs)	
CO1	Experiment concepts of DSP and its applications using MATLAB Software
CO2	To understand about the basic signal generation.
CO3	To learn Fourier Transform Concepts.
CO4	To design FIR filters.
CO5	To design IIR filters.
CO6	Demonstrate their abilities towards DSP processor-based implementation of DSP systems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3	3	3		3	3	3
	CO2	3	3	2	2	3										
	CO3	3	3	3	3	3			3	3	3	3				
	CO4	3	3	3	3	3			3	3	3	3				
	CO5	3	3	3	3	3			3	3	3	3				

	CO6	3	2	3	3					2	2						
3	Category	Professional Core (PC)															
4	Approval	48th Meeting of Academic Council															

U18PCEC5L	MICROWAVE ENGINEERING LAB	L	T	P	C
	Total Contact Hours – 30	0	0	2	1
	Prerequisite –Transmission Lines and Networks				
	Department:-Dept. of Electronics and Communication Engineering				

COURSE OBJECTIVES

Know about the behavior of microwave components.
Understand the radiation pattern of horn antenna.

LIST OF EXPERIMENTS

1. Study of microwave components
2. Characteristics of reflex klystron oscillator
3. Characteristics of gunn diode oscillator
4. Radiation pattern of horn antenna
5. Measurement of Antenna gain
6. Frequency and wavelength measurement
7. Impedance measurement by slotted line method
8. VSWR and Reflection Co-efficient measurement
9. Characteristics of E Plane/ H Plane Tee.
10. Characteristics of Magic Tee.
11. Characteristics of Directional coupler.

Experiments beyond the syllabus should be conducted.

Course Outcome (COs)	
CO1	Demonstrate the characteristics of Microwave sources
CO2	Demonstrate the characteristics of directional Couplers
CO3	To test the characteristics of microwave components
CO4	To analyze the radiation pattern of antenna.
CO5	To measure antenna gain
CO6	Practice microwave measurement procedures

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3		3	3		2		1					3	3	3
	CO2	2	1	3	3					3	2					
	CO3	2			3							1				
	CO4	2			3	2		2								
	CO5		2		3	2				1	2					
	CO6	3		3	3		2		1							
3	Category	Professional Core (PC)														
4	Approval															

U18MCAB509- SOCIAL AWARENESS (ARTISANS-RELATES TO ENGG., VISIT TO HOSPITALS, ORPHANAGES, POLICESTATION, COURTS, TRAUMA CENTERS, CONSUMER FORUMS)

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity-based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in Banarasi Saari, Toy making, etc. and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of actions.

U18MCAB510 SOCIAL SERVICE

(teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer)

U18PCEC601	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Transforms and Partial Differential equation				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems and study the effect of state feedback

UNIT I CONTROL SYSTEM MODELING 9

Introduction to control problem- Industrial Control examples. Transfer function. System with dead-time. System response. Translational and rotational mechanical systems, simple Electro - mechanical systems. Block diagram representation of systems. Block Diagram reduction methods. Closed loop transfer function, determination of Signal flow graphs. Mason's gain formula. Examples.

UNIT II TIME RESPONSE ANALYSIS 9

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. proportional, integral and derivative systems. Feed forward and multi-loop control configurations,..

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency-response analysis- Polar plots, Bode plot, Nyquist plots, M and N Circle, Performance specifications in frequency-domain. Frequency domain methods of design, Compensators-Lead, Lag and Lead-Lag compensation.

UNIT IV STABILITY ANALYSIS 9

Feedback control systems- stability concept, relative stability, Routh stability criterion, Nyquist stability criterion, Root locus method of design.

UNIT V STATE VARIABLE ANALYSIS 9

State variable Analysis- Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

TEXT BOOK:

1. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi
2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.

REFERENCES:

1. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
2. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.

Course Outcome (COs)	
CO1	Students will be able to determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
CO2	Students will be able to determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs
CO3	Students are able to determine the (absolute) stability of a closed-loop control system
CO4	Students are able to apply root-locus technique to analyze and design control systems.
CO5	Students are able to express and solve system equations in state-variable form (state variable models).
CO6	Students will be able to design the compensation technique that can be used to stabilize control

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	3	3	3			3	3	3	3	3	3	3	3
	CO2	3	1	2	3	3			3	3	2	2	3			

	CO3	3	1	3	3	3			3	2	2	2	3			
	CO4	3	2	3	3	2			2	2	3	2	3			
	CO5	3	2	3	2	2			2	2	2	3	3			
	CO6	3	3	3	3	2			2	3	2	2	3			
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC602	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Analog and digital communication				
	Department:-Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

- To make the students to understand the different layers of ISO /OSI model and TCP/IP Network IEEE standards.
- To understand IP addressing methods and QOS parameters.
- To know the functions and congestion control mechanism of TCP.
- To know about application layer and network security

UNIT I INTRODUCTION 9

Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic Mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

UNIT II SWITCHING NETWORKS 9

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical multiplexing.

UNIT III TRANSPORT LAYER 9

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

UNIT IV NETWORK LAYER 9

Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines congestion Control, Congestion Avoidance Mechanisms and Quality of Service. Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing

UNIT V DATALINK LAYER 9

ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

TEXT BOOK:

1. Behrus A. Forouzane.tal, “Data Communication and Networking”, Tata McGraw-Hill

REFERENCES:

1. William Stallings, "Data and Computer Communication", Fifth Edition, Prentice Hall of India,1997.
2. Andrew S.Tanenbaum, "Computer networks", Third Edition, prentice Hall of India, 1996.
3. www.studytonight.com/computer-network.

Course Outcome (COs)	
CO1	Explain the networks, topologies and layers of OSI model, compare with TCP/IP model.
CO2	Classify error control and flow control techniques and types of LAN technologies.
CO3	Analyze different routing algorithms and methods to improve QOS.
CO4	Explain the role of protocols in networking.
CO5	Summarize the transport layer protocols and congestion controls methods.
CO6	Describe various application layer services and cryptographic techniques.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3			2	2				3	1	1	3	3	3
	CO2	2	1							2						
	CO3	2	3	2	2			3			2					
	CO4	2	3	2	2	3		2		2		3	3			
	CO5								1	3						
	CO6	3					2									
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC603	**BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Nil				
	Department:- Department of Electronics & Communication Engineering				

COURSE OBJECTIVES: The objective of the course is to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance.

UNIT I BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

PH, PO2, PCO2, PHCO3, Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.

UNIT II ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, EOG, lead systems and recording methods, typical waveforms and signal characteristics

UNIT III ASSIST DEVICES AND BIO-TELEMETRY 9

Cardiac pacemakers, DC Defibrillator, Telemetry principles, frequency selection, Biotelemetry, radio-pill and tele-stimulation.

UNIT IV RADIOLOGICAL EQUIPMENTS 9

Ionizing radiation, Diagnostic x-ray equipment's, use of Radio Isotope in diagnosis, Radiation Therapy.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Thermograph, endoscopy unit, Laser in medicine, Diathermy units, Electrical safety in medical equipment.

TEXT BOOK:

1. Khandpur, R.S., ―Handbook of Biomedical Instrumentation‖, TATA McGraw-Hill, New Delhi, 1997.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 .

REFERENCES:

1. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation',John Wiley & Sons, 1975.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.
5. https://lecturenotes.in/subject/27/biomedical-instrumentation-bi

Course Outcome (COs)	
CO1	To introduce the student to the various sensing and measurement devices of electrical origin
CO2	To Know about the origin of Bio-potentials; bio potential electrodes, biological amplifiers
CO3	To know about the ECG, EEG, EMG, PCG, EOG
CO4	To know about cardiac pacemakers, DC Defibrillator, Bio-telemetry
CO5	To know about Diagnostic x-ray equipments, Radiation Therapy,
CO6	To know about Endoscopy unit, Laser in medicine, Electrical safety in medical equipment

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	1	1	3	2			2	1		2		3	3	3
	CO2	3	2	2	3	2			2	2		2				
	CO3	3	2	3	2	2			2	1		2				
	CO4	2	1	1	2	2			2	1		1				
	CO5	3	2	2	2	1			2	1		2				
	CO6	3	1	1	2	3			2	2		3				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC6L1	COMPUTER NETWORKS LAB	L	T	P	C
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – **Computer Networks**				
	Department:- Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

To understand the working principle of various communication protocols.
To analyze the various routing algorithms.
To know the concept of data transfer between nodes.

List of Experiments

1. Creation and transmission of data between two nodes with duplex link
2. Data transmission between multiple sender and one receiver via router
3. TCP Scenario with droptail queue mechanism
4. Simulate a complex topology with a link failure
5. Creation and transmission of data between two nodes via wireless link
6. Simulation of Different network topology
7. Implementation and study of stop and wait protocol
8. Implementation and study of Goback-N and selective repeat protocols
9. Implementation of distance vector routing algorithm
10. Implementation of Link state routing algorithm
11. Implementation of Data encryption and decryption

Course Outcome (COs)	
CO1	Understand fundamental underlying principles of computer networking
CO2	Understand details and functionality of layered network architecture.
CO3	Apply mathematical foundations to solve computational problems in computer networking
CO4	Analyze performance of various communication protocols.
CO5	Compare routing algorithms
CO6	Practice packet /file transmission between nodes.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation)
3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3	3	2	2	3	3	3
	CO2	3	3	3	3	3			3	3	3	2				
	CO3	3	3	3	3	2			2	3		2				
	CO4	3	3	3	3	3			3	3	3	3	3			
	CO5	3	3	3	3	2			3	3	3	2				
	CO6	3	3	3	3	3			3	3	3	2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18PCEC6L2	ELECTRONICS MEASUREMENT LAB	L	T	P	C
	Total Contact Periods – 45	0	0	2	1
	Prerequisite – Basic Electrical and Electronics Engineering				
	Department:- Department of Electronics & Communication Engineering				

COURSE OBJECTIVES

To introduce students to the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements
To provide students with opportunities to develop basic skills in the design of electronic equipment's.
To experimentally verify the principle and characteristics of various transducers.
To introduce students a knowledge to use modern tools necessary for electrical projects.
To provide a student a knowledge to design and create novel products and solutions for real life problems.
To impart the students with an adequate knowledge and work experience of the different types of bridges

List of Experiments

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Designing AC bridge Circuit for capacitance measurement
3. Designing signal Conditioning circuit for Pressure Measurement
4. Designing signal Conditioning circuit for Temperature Measurement
5. Designing signal Conditioning circuit for Torque Measurement
6. Designing signal Conditioning circuit for Strain Measurement
7. Experimental study for the characteristics of ADC and DAC
8. Error compensation study using Numerical analysis using MATLAB (regression)

Course Outcome (COs)	
CO1	Students will be able to design and validate DC and AC bridges
CO2	Students will be able to analyze the dynamic response and the calibration of few instruments
CO3	Students are able to learn about various measurement devices, their characteristics, their operation and their limitations
CO4	Students are able to understand statistical data analysis
CO5	Students are able to understand computerized data acquisition.
CO6	Students will be able to learn about the various types of electrical transducers

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	2	2			2	2	3	2		3	3	3
	CO2	2	3	2	2	1			1	1	2	2				
	CO3	2	3	2	3	2			2	3	2	2				
	CO4	2	3	2	2	2			3	3	1	3				
	CO5	2	3	2	3	3			3	2	2	2				
	CO6	2	3	2	3	3			3	3	1	2				
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCAB611 SPIRITUAL, MINDFULNESS AND MEDITATION

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's

attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques Aug be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.
The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They Aug work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students Aug learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities

Reading (10 books/ narrations)
Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions: multiple 10-day sessions Aug be organized over a semester.

U18MCAB612 RELIGION AND INTER-FAITH

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods Aug be as suggested under 'book reading'.)
Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

U18PCEC701	**EMBEDDED SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Microcontroller				
	Department:-Dept of Electronics & Instrumentation Engineering				
COURSE OBJECTIVES To introduce the Building Blocks of Embedded System To Educate in Various Embedded Development Strategies					

To Introduce Bus Communication in processors, Input/output interfacing.
To impart knowledge in various processor scheduling algorithms.
To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

UNIT I EMBEDDED DESIGN WITH MICROCONTROLLERS 9

Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Microprocessor Vs Micro Controller – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits – RTOS Micro Controller - issues in selection of processors.

UNIT II PARTITIONING DECISION 9

Hardware / Software duality – Hardware-Software portioning- coding for Hardware- software development – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization –memory enhancement – Firmware-speed and code density -System startup.

UNIT III FUNCTIONALITIES FOR SYSTEM DESIGN 9

Timers, Watch dog timers – RAM, Flash Memory basic toolset – Integration of Hardware & Firmware- in System Programming, in Application Programming, IDE-Target Configuration-Host based debugging – Remote debugging – ROM emulators – Logic analyzer.

UNIT IV REAL TIME OPERATING SYSTEMS 9

Definitions of process, tasks and threads - Clear cut distinction between functions - ISRs and tasks by their characteristics - Operating System Services- Goals - Structures- Kernel - Process Management - Memory Management - Device Management - File System Organisation and Implementation - I/O Subsystems - Interrupt Routines Handling in RTOS, REAL TIME OPERATING SYSTEMS : RTOS Task scheduling models - Handling of task scheduling and latency and deadlines as performance metrics - Co-operative Round Robin Scheduling - Cyclic Scheduling with Time Slicing (Rate Monotonics Co-operative Scheduling) - Preemptive Scheduling Model strategy by a Scheduler - Critical Section Service by a Preemptive Scheduler - Fixed (Static) Real time scheduling of tasks - Inter Process Communication and Synchronisation - Shared data problem - Use of Semaphore(s) - Priority Inversion Problem and Deadlock Situations - Inter Process Communications using Signals - Semaphore Flag or mutex as Resource key - Message Queues - Mailboxes - Pipes - Virtual (Logical) Sockets - Remote Procedure Calls (RPCs).

UNIT V EMBEDDED DESIGN LIFE CYCLE & TESTING 9

Objective, Need, different Phases & Modeling of the EDLC, choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Software &Hardware Design, PCB Design, Manufacturing & PCB Assembly-Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

TEXT BOOK:

1. James K.Peckol, “Embedded system Design”, John Wiley & Sons, 2010
2. Lyla B.Das, “Embedded Systems an integrated Approach”, Pearson, 2013

REFERENCES:

1. Rajkamal, ”Embedded Systems”, TMH, 2009.
2. Arnold S. Berger –“Embedded System Design”, CMP books, USA 2002
3. http://www.crectirupati.com/sites/default/files/lecture_notes/final%20ES.pdf

Course Outcome (COs)	
CO1	Acquire a basic knowledge about fundamentals of microcontrollers
CO2	Acquire a basic knowledge about programming and system control to perform a specific task.
CO3	Acquire knowledge about devices and buses used in embedded networking
CO4	Develop programming skills in embedded systems for various applications.
CO5	Acquire knowledge about basic concepts of REAL Time Operating Systems
CO6	Build complex embedded system with the use of RTOS.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	2	3	3	2			2	3	3	3	1	3	3	3
	CO2	3	2	3	3	3			2	3	3	3	1			
	CO3	3	2	3	3	3			2	3	3	3	1			
	CO4	3	2	3	3	3			2	3	3	3	1			
	CO5	3	2	3	3	3			2	3	3	3	1			
	CO6	3	2	3	3	3			2	3	3	3	1			
3	Category	Professional Core (PC)														
4	Approval	48th Meeting of Academic Council														

U18MCTH603	**Essence of Indian Knowledge Tradition**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVE

- It will also focus on Indian philosophical, linguistic and artistic traditions, along with yoga and Indian perspective of modern scientific worldview.

The course aims at imparting basic principles of thought process, reasoning and inferencing

U18MCAB713 BEHAVIORAL AND INTERPERSONAL SKILLS (NON-VERBAL SKILLS / BEHAVIOURS, NON-AGGRESSION)

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which Aug lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

- To help the students to understand their real self by recognizing different aspects of their self-concept that will lead to an increased self-confidence.
- To train the students for communicating effectively in both formal as well as in informal settings.
- To help the students to understand the importance of non-verbal aspects of effective communication.
- To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work
- To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.
- To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

- Motivational lectures
- Group Discussions/activities
- Case Study
- Games/Stimulation Exercises
- Role-Playing
- Mindfulness training.

U18MCAB714- NATURE

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.
Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18MCAB815 INNOVATION PROJECT BASED – SC., TECH, SOCIAL, DESIGN & INNOVATION

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which Aug result in development

of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students Aug be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities Aug be undertaken under this

Exposure to social problems (which are amenable to technological solutions)
Design & Innovation (to address above problems)

After this student, be encouraged to undertake technology projects of social relevance.

PROFESSIONAL ELECTIVES

U18PEEC011	INFORMATION THEORY AND CODING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Probability and Stochastic Processes, Analog and Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

The student should be made to:

- Understand error–control coding.
- Understand encoding and decoding of digital data streams.
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- Be aware of compression and decompression techniques.
- Learn the concepts of multimedia

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

UNIT II DATA AND VOICE CODING 9

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT III ERROR CONTROL CODING 9

Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes.

UNIT IV COMPRESSION TECHNIQUES 9

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

UNIT V AUDIO AND VIDEO CODING 9

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

TEXT BOOK:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2001.
2. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002; Chapters: 3,4,5.

REFERENCES:

1. Mark Nelson, "Data Compression Book", BPB Publication 1992.
2. Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995.
3. https://lecturenotes.in/subject/540/information-theory-coding-itc

COURSE OUTCOMES (COs)	
CO1	Design an application with error–control
CO2	Use compression and decompression techniques
CO3	Apply the concepts of multimedia communication
CO4	Discuss about various error control coding
CO5	To study about audio coding techniques
CO6	To study about video coding techniques

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
2	CO1	2	3	3	1	2			2	1	1	2		3	3	3
	CO2	3	3	2	2	2			2	1		3				
	CO3	3	2	3	2	2			2	2	2	3				
	CO4	2	2	2	3	2			3		1	2				
	CO5	3	2	2	3	2			2		1	2				
	CO6	3	2	2	2	2			2	1	1	2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meeting of the Academic Council,														

U18PEEC012	**SPEECH & AUDIO PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital Signal Processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To introduce speech production and related parameters of speech.

To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.

To understand different speech modeling procedures such as Markov and their implementation issues

UNIT I BASIC CONCEPTS 9

Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods. Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital

UNIT II SPEECH ANALYSIS 9

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT III SPEECH MODELING 9

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION 9

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS 9

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TEXT BOOK:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.
3. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.

REFERENCES:

1. Steven W. Smith, “The Scientist and Engineer‟s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.
3. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
4. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006.
5. https://nptel.ac.in/courses/117105145/

COURSE OUTCOMES (COs)	
CO1	Model speech production system and describe the fundamentals of speech.
CO2	Extract and compare different speech parameters.
CO3	Choose an appropriate statistical speech model for a given application.
CO4	Design a speech recognition system.
CO5	Use different speech synthesis techniques.
CO6	To study about speech analysis and modeling

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	3	2	2			2	2	2			3	3	3
	CO2	3			2							2	2			
	CO3	3		3		2							2			
	CO4	3	2		2				2				2			
	CO5	3	2	3		2				3	2	2				
	CO6	3	3	3	2	2			2	3	2					
3	Category	Professional Elective (PE)														
4	Approval	49th Meeting of the Academic Council,														

U18PEEC013	CELLULAR MOBILE COMMUNICATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Analog and Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To understand the basic cellular system concepts.

To have an insight into the various propagation models and the speech coders used in mobile communication.

To understand the multiple access techniques and interference education techniques in mobile communication

UNIT I INTRODUCTION TO WIRELESS MOBILE COMMUNICATION 9

History and evolution of mobile radio systems, Types of mobile wireless services/systems – Cellular, WLL, Paging, Satellite systems, Standard, Future trends in personal wireless systems.

UNIT II CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS 9

Cellular concept and frequency reuse, Multiple Access Schemes, Channel assignment and handoff, Interface and system capacity, Trucking and Erlang capacity calculations.

UNIT III MOBILE RADIO PROPAGATION 9

Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and based and impulse models, Parameters of mobile multipath channels, Antenna systems in mobile radio.

UNIT IV MODULATION AND SIGNAL PROCESSING 9

Analog and digital modulation techniques, Performance of various modulation techniques – Spectral efficiency, Error rate, Power Amplification, Equalization/Rake receiver concepts, Diversity and Space-time processing, Speech coding and channel coding.

UNIT V SYSTEM EXAMPLES AND DESIGN ISSUES 9

Multiple Access Techniques – FDMA, TDMA and CDMA Systems, Operational Systems, Wireless networking, design issues in personal wireless systems.

TEXT BOOK:

1. K. Feher, Wireless Digital Communication, Prentice Hall of India, New Delhi, 1995.

REFERENCES:

1. T.S. Rappaport, Wireless Communication; Principles and Practice, Prentice Hall, NJ, 1996.
2. W.C.Y. Lee, Mobile Communication Engineering; Theory and Application, Second Edition, McGraw-Hill International, 1998.

3. https://en.wikipedia.org/wiki/Cellular_network

COURSE OUTCOMES (COs)	
CO1	Discuss cellular radio concepts
CO2	Identify various propagation effects
CO3	To have knowledge of the mobile system specifications.
CO4	Classify multiple access techniques in mobile communication.
CO5	Outline cellular mobile communication standards.
CO6	Analyze various methodologies to improve the cellular capacity

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3			1	2			2			2		2	2	2
	CO2	2			1	2			1	2		2				
	CO3	2		2	2	1			1			2	3			
	CO4	3				2			2	2		1				
	CO5	2			1	2			1	1		2				
	CO6	2			2				2	1		2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC014	FPGA AND SYSTEM ON CHIP	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Digital System Design				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To make the students to learn the role of FPGA's and ASIC are perceived to be enormous in embedded systems.

To make the student learn, FPGA fundamentals, design and implementation of circuits in them.

To make the student learn System-on-chip fundamentals, their applications and On-chip networking methods**.**

To give the student an understanding of basics of System on Chip and Platform based design

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN 9

Types of ASICs – Design Flow – CMOS transistors, CMOS design rules – Combinational Logic Cell – Sequential logic cell – Data path logic cell – Transistors as Resistors – Transistor Parasitic Capacitance – Logical effort –Library cell design –Library architecture.

UNIT II PROGRAMMABLE LOGIC CELLS AND I/O CELLS 9

Anti fuse – static RAM – EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA –Altera FLEX – Altera MAX DC & AC inputs and outputs – Clock and power inputs – Xilinx I/O block

UNIT III ASIC DESIGN SOFTWARE, FLOOR PLANNING, PLACEMENT AND ROUTING 9

Actel ACT – Xilinx LCA – Xilinx EPLD – Altera MAX 5000 and 7000 – Altera MAX 9000 Altera FLEX – System partition – FPGA partitioning – partitioning methods – floor planning – placement – physical design flow –global routing – detailed routing – special routing – circuit extraction – DRC.

UNIT IV SOC FUNDAMENTALS, SOFTWARE AND ENERGY MANAGEMENT 9

Essential issues of SoC design – A SoC for Digital still camera – multimedia IP development: Image and video codecs. SoC embedded software – energy management techniques for SoC design.

UNIT V SYSTEM DESIGN AND METHODOLOGY, SOFTWARE AND APPLICATION INTERFACES 9

Design methodology for NOC based systems – Mapping concurrent application onto architectural platforms.MP-SoC from software to hardware – NoC APIs – multilevel software validation for NoC – Software for network on chip.

TEXT BOOK:

1. M.J.S. SMITH, "Application Specific Integrated Circuits", Addison Wesley Longman Inc., 1997.
2. Wolf Wayne, "FPGA Based System Design", Pearson Education India, 2004.
3. Youn-Long, Steve Lin, "Essential Issues of SoC Design: Designing Complex Systems-On-Chip", Springer,2006.

REFERENCES:

1. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994.
2. Design manuals of Altera, Xilinx and Actel. (From the web).
3. Axel Jantsch, HannuTenhunen, "Network on chips", Kluwer Academic Publishers, 2003.
4 J..M.Rabaey,A.Chandrakasan, B.Nikolic,"Digital Integrated Circuit Design Perspective (2/e)", PHI 2003.
5. D. A.Hodges, "Analysis and Design of Digital Integrated Circuits (3/e)", MGH 2004.
6. https://www.mepits.com/tutorial/421/vlsi/system-on-chip

COURSE OUTCOMES (COs)	
CO1	Demonstrate VLSI tool-flow and appreciate FPGA architecture
CO2	understand the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design
CO3	To study the programmable logic cells and i/o cells and understand the algorithms used for ASIC construction
CO4	understand the basics of System on Chip, On chip communication architectures like AMBA,AXI and utilizing Platform based design
CO5	To study the design principles of FPGA and PLA.
CO6	To learn various floor planning methods for system design.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1		2			3	2		3	2		3		3	3	3

	CO2		3		2			3	2		1					
	CO3		2	1				2	1	3		1	3			
	CO4	3			1	3			2		3	2				
	CO5			3			2		2		3					
	CO6	3				2			3	2		3	2			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC015	DESIGN OF SEMICONDUCTOR MEMORIES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Semiconductor Physics				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To study the architectures for SRAM and DRAM
To know about various non-volatile memories.
To study the fault modeling and testing of memories for fault detection.
To learn the radiation hardening process and issues for memory.
To know about Ferroelectric Random Access Memories (FRAMs).

UNIT I RANDOM ACESS MEMORY TECHNOLOGY 9

Static Random Access Memories(SRAM) SRAM Cell Structure-MOS SRAM Architecture-MOS SRAM Cell and Peripherals Circuit Operation – Bipolar SRAM Technologies –Silicon On Insulator (Sol) Technology – Advanced SRAM Architecture and Technologies – Application Specific SRAMs Dynamic Random Access Memoirs(DRAMs) DRAM Technology Development – CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures-BICMOS DRAMs – Soft Error Failure in DRAMs – Advanced DRAM Designs and Architecture – Application Specific DRAMs.

UNIT II NON-VOLATILE MEMORIES 9

Mask Read Only Memories (ROMs)-High Density ROMs-Programmable Read Only Memories(PROMs)-Bipolar PROMs CMOS PROMs-Erasable (UV) – Programmable Read Only Memories(EPROMs) - Floating – Gate EPROM Cell-One Time Programmable (OTP) EPROMs -Electrically Erasable PROMs(EEPROMs) – EEPROM Technology and Architecture – Non Volatile SRAM – Flash Memories (EPROM or EEPROM)

UNIT III MEMORY FAULTS MODELLING, TESTING AND MEMORY DESIGN FOR TESTABILITY AND FAULT TOLERANCE 9

RAM Fault, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault modeling and Testing-Application Specific Memory Testing

UNIT IV SEMICONDUCTOR MEMORY RELIABILITY AND RANDOM EFFECTS 9

General Reliability Issues-RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability – Reliability Modeling and Failure Rate Prediction – Design for Reliability – Reliability Test Structures – Reliability Screening and Qualification. Radiation Effects-Single Event Phenomenon (SEP) – Radiation Hardened Memory Characteristics – Radiation Hardness Assurance and Testing – Radiation Dosimettry - Water Level Radiation Testing and Test Structures.

UNIT V ADVANCED MEMORY TECHNOLOGIES AND HIGH-DENSITY MEMORY PACKAGING TECHNOLOGICS 9

Ferroelectric Random-Access Memories (FRAMs) – Gallium Arsenide (GaAs) FRAM – Analog Memories Magneto Resistive Ferroelectric Random-Access Memories (MRAMS) – Experimental Memory Devices Memory Hybrids and MCMs (2D – Memory Stacks and MCMs 3D) – Memory MCM Testing and Reliability Issues – Memory Cards – High Density Memory Packing Feature Directions.

TEXT BOOK:S

1. Ashok K. Sharma, "Semiconductor Memories Technology, Testing, and Reliability", Prentice Hall of India Limited. New Delhi 1997.
2. Ashok K Sharna, Advanced Semiconductor Memories – Architecture, Design and Applications, Wiley 2002.

REFERENCES:

1. Anjan Ghosh, High Speed Semiconductor Devices, NPTEL Courseware, 2009.
2. Luecke Mize Care, "Semiconductor Memory design & application", Mc-Graw Hill.
3. Belty Prince, " Semiconductor Memory Design Handbook".
4. Memory Technology design and testing 1999 IEEE International Workshop on: IEEE Computer Society Sponsor (S).
5. http://bwrcs.eecs.berkeley.edu/Classes/IcBook/SLIDES/slides10.pdf

COURSE OUTCOMES (COs)	
CO1	Design Memory Structures.
CO2	Decide the type of memory for a specific application.
CO3	Describe the smartness in the circuits used for memories.
CO4	Design the architectures of Static and Random Access, Nonvolatile memories
CO5	Evaluate the fault modeling and testing procedures for memory circuit
CO6	Identification of new developments in semiconductor memory design.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3		3			2		3	2		3	3	3
	CO2	2		3	2	3				3	1					
	CO3		3	1		3		2	1		2	1				
	CO4	1		2	1	3	2		2		3	2				
	CO5	2														
	CO6	2		3	2	3			3	2		3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC016	**MIXED SIGNAL DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Analog Circuits & Signals and Systems				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To know the fundamentals of Signals, Filters and Sampling process
To understand the design techniques of analog and digital filters Structures
To know the fundamentals of analog and digital conversion techniques in logical design

UNIT I SIGNALS, FILTERS AND SAMPLING 9

Sinusoidal Signals, Comb Filters, Representing Signals, Impulse Sampling, Decimation, The Sample-and-Hold, Interpolation, K-Path Sampling, The Track-and-Hold Implementing the S/H, The S/H with Gain, The Discrete Analog Integrator.

UNIT II ANALOG FILTERS 9

Integrator Building Blocks- Lowpass Filters, Active-RC Integrators, MOSFET-C Integrators, gm-C (Transconductor-C) Integrators, Discrete-Time Integrator, Filtering Topologies- The Bilinear Transfer Function, The Biquadratic Transfer Function.

UNIT III DIGITAL FILTERS 9

SPICE Models for DACs and ADCs- The Ideal DAC, The Ideal ADC, Number Representation, Sinc-Shaped Digital Filters- The Counter, Lowpass Sinc Filters, Bandpass and Highpass Sinc Filters, Interpolation using Sinc Filters, Decimation using Sinc Filters, Filtering Topologies- FIR Filters, Stability and Overflow, The Bilinear Transfer Function, The Biquadratic Transfer Function

UNIT IV DATA CONVERTER FUNDAMENTALS 9

Analog Versus Discrete Time Signals, Converting Analog Signals to Digital Signals, Sample-and-Hold (S/H) Characteristics, Digital-to-Analog Converter (DAC) Specifications, Analog-to-Digital Converter (ADC) Specifications, Mixed-Signal Layout Issues.

UNIT V DATA CONVERTER ARCHITECTURES 9

DAC Architectures- Digital Input Code, Resistor String, R-2R Ladder Networks, Current Steering, Charge-Scaling DACs, ADC Architectures- Flash, The Two-Step Flash ADC, The Pipeline ADC, Integrating ADCs, The Successive Approximation ADC, The Oversampling ADC.

TEXTBOOK:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008.
4. Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
5. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

REFERENCES:

1. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
2. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).
3. https://www.youtube.com/playlist?list=PLLDC70psjvq5vtrb0EdII4xIKA15ec-Ij

COURSE OUTCOMES (COs)	
CO1	Understand the practical situations where mixed signal analysis is required.
CO2	Analyze and handle the inter-conversions between signals. Design systems involving mixed signals
CO3	To understand the various conversion architectures for analog and digital signal processing.
CO4	To be able to design analog and digital filters Structures.
CO5	To be able to carry out the filters design in data conversions.

CO6	To be able to design conversion architectures for DSP algorithms.														
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	2	2	2				2	2			3	3	3
	CO2	3	2	3	2					2		2				
	CO3	3	3	2	2					2						
	CO4	3	3	3	3	3				3	3	3				
	CO5	3	2	3	3	3				3	3					
	CO6	3	3	3	2					2	2	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council,														

U18PEEC021	ERROR CORRECTING CODES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Digital System Design				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

Theory and application of error detecting and correcting codes.
Encoding, decoding and error correcting techniques.
System control with emphasis on hardware implementation

UNIT 1 INTRODUCTION TO CODING 9

Basic Definitions, Block Codes and Maximum Likelihood Decoding, Decoding Tables, Hamming Weight and Distance, Error Correction Vs Detection

UNIT II LINEAR BLOCK CODES 9

Definitions, Generator Matrix, Parity-Check Matrix, Error-Correcting Capability of a Linear Code, The Standard Array

UNIT III BINARY CYCLIC CODES 9

Description of Cyclic Codes, encoding with (n-k)-Stage Shift Register, Syndrome Calculations and Error Detection, A General Decoder for Cyclic Codes, Shortened Cyclic Codes

UNIT IV ERROR TRAPPING DECODING FOR CYCLIC CODE 9

Error Trapping Decoding, Hamming Codes, Double-Error-Detecting and Single-Error Correcting Hamming Codes, A Modified Error-Trapping Decoding, Oley Code

UNIT V BCH CODES 9

Description of Codes, Decoding of the BCH Codes, Implementation of Error Correction, Non binary BCH Codes and Reed-Solomon Codes, Single-Burst-Error-Correcting Codes, Burst-and-Random-Error-Correcting Codes, Error Detecting and Correcting Systems Design and Hardware Implementation

TEXT BOOK:

1. Nagi El Naga, “Error Detecting and Correcting Systems Design,” Lecture Notes, ECE Department, California State University, Northridge.

REFERENCES:

1. Shu Lin, "An Introduction to Error-Correcting Codes", Prentice-Hall
2. Wakerly, John, "Error Detecting Codes, Self-Checking Circuits and Applications."
3. Peterson, W. W. and E.J. Weldon, Jr., "Error-Correcting Codes", the M.I.T. Press, Cambridge, MA 1970
4. Lin, Shu/D. J. Costello, Jr., "Error Control Coding: Fundamentals and Applications", Prentice-Hall, 1983

5.http://www.cs.cmu.edu/~odonnell/toolkit13/lecture10.pdf

COURSE OUTCOMES (COs)	
CO1	Understand Block Codes and Maximum Likelihood Decoding.
CO2	Understand Decoding Tables, Hamming Weight and Distance and Error Correction Vs Detection.
CO3	Understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code.
CO4	Design an error detecting and correcting system for semiconductor memory system to meet given system specification.
CO5	Understand Binary Cyclic Codes, encoding with (n-k)-Stage Shift Register and Syndrome Calculations and Error Detection
CO6	Design an error detecting and correcting system for magnetic storage device to meet given system specification.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
2	CO1	2	1	1	2	2			2	1		1		3	3	3
	CO2	2	1		2	2			2	2		1				
	CO3	3	1		2	2			2	1						
	CO4	2	2	1	2	2			2	2	1	2				
	CO5	2			2	2			3	2		3				
	CO6	3	3	2	2	2			1	2	1	2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC022	**WIRELESS COMMUNICATION NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Computer Network and Analog & Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To provide the students with the fundamental treatment about many practical and theoretical concepts that forms basic of wireless communications.

To equip the students with various kinds of wireless networks and its operations.

To prepare students to understand the concept of frequency reuse and be able to apply it in the design of mobile cellular system.

UNIT I THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS 9

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies-Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity — Co channel Interference and system capacity, Channel planning for Wireless Systems,

Adjacent Channel interference ,Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems.

UNIT II MOBILE RADIO PROPAGATION 9

Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Outdoor Propagation Models,lndoor Propagation Models, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT III MOBILE RADIO PROPAGATION 9

Small Scale Fading and Multipath: Small Scale Multipath Propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel-Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels.

UNIT IV EQUALIZATION AND DIVERSITY 9

Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer.

UNIT V WIRELESS NETWORKS 9

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOK:

1. Wireless Communications, Principles, Practice — Theodore, S.Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication — Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCES:

1. Principles of Wireless Networks — Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
2. Wireless Digital Communications — Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking — William Stallings, 2003, PHI.
4. Wireless Communication — Upen Dalal, Oxford Univ. Press
5. Wireless Communications and Networking — Vijay K. Gary, Elsevier.
6. https://www.academia.edu/6383890/Wireless_Communications_and_Networking_by_William_Stallings_2nd_Edition

U18PEEC023	**WIRELESS SENSOR NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To Obtain a broad understanding about the network architecture of wireless sensor network.
To Understand all basic characteristics of wireless sensor networks and sensor nodes.

COURSE OUTCOMES (COs)	
CO1	Understand the principles of wireless communications.
CO2	Understand fundamentals of wireless networking
CO3	Understand cellular system design concepts.
CO4	Analyze various multiple access schemes used in wireless communication.
CO5	Understand wireless wide area networks and their performance analysis.
CO6	Demonstrate wireless local area networks and their specifications.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3			2	2			1	3		3		3	3	3
	CO2	2	1		2	2			2	1						
	CO3	3	2	2	1	2			2			2				
	CO4	3	1		1	2			1			2	2			
	CO5	2	1		2	2			3	2		2				
	CO6	2	2		1	2			2	1		1				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

To learn the principles of data transmission, clustering algorithm and routing protocols.
To Understand different constraint of wireless sensor network, e.g., coverage, power management, security and data collisions.
To Design and development of new network architecture and MAC protocols

UNIT I BASIC WIRELESS SENSOR TECHNOLOGY AND APPLICATIONS 6

Introduction, Sensor Node Technology, Sensor Taxonomy, Examples of Category 1 WSN Applications, Examples of Category 2 WSN Applications, WN Trends.

UNIT II MEDIUM ACCESS CONTROL PROTOCOLS FOR WIRELESS SENSOR NETWORKS 9

Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSN, Sensor-MAC Case Study, IEEE 802.15.4 LR-WPANs Standard Case Study

UNIT III ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORK 12

Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Network, Routing Strategies in Wireless Sensor Networks, Traditional Transport Control Protocols, Examples of Existing Transport Control Protocols

UNIT IV MIDDLEWARE FOR WIRELESS SENSOR NETWORKS 6

Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware

UNIT V OPERATING SYSTEM & NETWORK MANAGEMENT FOR WIRELESS SENSOR NETWORKS 12

Introduction, Network Management Requirements, Traditional Network Management Models Network Management Design Issues, Example of Management Architecture: MANNA, Other Issues Related to Network Management, Operating System Design Issues, TinyOS, Mate, Magnet OS, MANTIS.

TEXT BOOK:

1. WIRELESS SENSOR NETWORKS Technology, Protocols, and Applications, Kazem Sohraby Daniel Minoli Taieb Znati, Copyright 2007 by John Wiley & Sons, Inc.

REFERENCES:

1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009
6. http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02

COURSE OUTCOMES (COs)	
CO1	Design wireless sensor networks for a given application
CO2	Understand emerging research areas in the field of sensor networks
CO3	Understand MAC protocols used for different communication standards used in WSN
CO4	Explore new protocols for WSN
CO5	Understand Middleware of wireless sensor networks
CO6	Understand the operating system and network management of WSN

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	3	3	3		3	3	3
	CO2	2	3	3	2	2			2	3	3	3				
	CO3	2	3	3	2	2			2	3	3	3				
	CO4	2	3	3	2	2			2	3	3	3	2			
	CO5	2	3	3	2	2			2	3	3	3				
	CO6	2	3	3	2	2			2	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC024	**ASIC DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Digital System design				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To acquire knowledge about different types of ASICs design.
To study about various types of Programmable ASICs architectures and interconnects

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN 9

Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS 9

Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN 9

Entry: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Low level design language - PLA tools EDIF- CFI design representation.

UNIT IV SYSTEM ON-CHIP DESIGN 9

Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design-FPGA to ASIC conversion – Design for integration-SOC verification-Set top box SOC.

UNIT V PHYSICAL AND LOW POWER DESING 9

Over view of physical design flow- tips and guideline for physical design- modern physical design techniques- power dissipation-low power design techniques and methodologies-low power design tools- tips and guideline for low power design.

TEXT BOOK:

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson Education, 2008

REFERENCES:

1. Wayne Wolf, "FPGA-Based System Design", Prentice Hall PTR, 2009.
2. Farzad Nekoogar and Faranak Nekoogar, "From ASICs to SOCs: A Practical Approach", Prentice Hall PTR, 2003.
3. www.vhdl.org/rassp/vhdl/guidelines/DesignReq.pdf

COURSE OUTCOMES (COs)	
CO1	Recognize need for programmable devices.
CO2	Describe architecture of programmable devices.
CO3	Explain programmable methodologies.
CO4	Recall IC fabrication techniques vis-à-vis CMOS switch.
CO5	Relate design and implementation flow for PLDs.
CO6	Low power design techniques and methodologies.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3		2		2	2	2	3	2		1	1	3	3	3
	CO2	2	1	3				3		1	3					
	CO3	2	3	2				2	2	2		3	3			
	CO4	2	3	3		2				2		2	2			
	CO5		1			2	2	2		1		2	2			
	CO6				2	2	3	2								
3	Category	Professional Elective (PE)														
4	Approval	49th Meeting of the Academic Council,														

U18PEEC025	**TESTING AND VERIFICATION OF ELECTRONIC CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic electrical and electronics, Electronic circuits				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVE:-

Gain knowledge on the basics of testing and the testing equipment's
Emphasize the needs of fault modeling and simulation
Interpret different testing methods of combinational and sequential Circuits.

UNIT I INTRODUCTION 9

Introduction to Testing: Testing philosophy, Role of testing, Digital and analog circuit testing, Technology trends affecting testing, Test Equipment's, Economics and Quality: Test economics, Defining cost, Benefit-cost analysis, The rule of ten, Yield.
Verification: Importance of verification, Verification plan, Verification flow, Levels of verification, Verification methods and languages. Functional Verification: Introduction to test bench, Test bench architecture, Types of test benches.

UNIT II FAULT SIMULATION AND TESTABILITY MEASURES 9

Simulation for Design Verification, Simulation for Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-Value Simulation, Algorithms for Fault Simulation, SCOAP Controllability and Observability.

UNIT III TESTING AND TESTABILITY OF COMBINATIONAL CIRCUITS 9

Test Generation Techniques: One dimensional path sensitization, Boolean Difference, D-Algorithm, PODEM, FAN, Delay Fault Detection. Detection of multiple faults, The Reed-Muller Expansion Technique, Three level OR-AND-OR Design, Automatic Synthesis of Testable Logic, Testable PLA Design

UNIT IV TESTING AND TESTABILITY OF SEQUENTIAL CIRCUITS 9

Testing of sequential circuits as iterative combinational circuits, State Table Verification, Test Generation based on Circuit Structure, Ad Hoc Design Rules, Scan Path Technique, Partial Scan and Boundary Scan

UNIT V DELAY TEST AND IDDQ TEST 9

Delay Test Problem, Path-Delay Test, Faults Detected by IDDQ Tests, IDDQ Testing Methods, Limitations of IDDQ Testing, IDDQ Built-In Current Testing, IDDQ Design for Testability

TEXT BOOK:

2. Michael L. Bushnell and Vishwani D. Agarwal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits", Springer, 2006.
2. P. K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
3. Dimitris Gizopouilos, "Advances in Electronic Testing", Springer 2006. Course nature

REFERENCES:

1. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits, Kluwer.
2. Janick Bergeron, Writing Testbenches, Functional Verification of HDL Models, Springer.
3. Abramovici, M. A. Breuer and A. D. Friedman, Digital Systems Testing and Testable Design, Wiley/IEEE Press.
4. Laung-Terng Wang et al., VLSI Test Principals and Architecture:, Morgan Kaufman.
5. https://pdfs.semanticscholar.org/997c/0204674bff79f5542ac7e78ddbe448bed15b.pdf

COURSE OUTCOMES (COs)	
CO1	Understand the need of testing also able to identify the different characteristics of verification, validation, testing and diagnosis in context of electronic circuits.

CO2	Effectively use the different verification tools and methods
CO3	Effectively use the automatic test equipment and automatic test pattern generator
CO4	Add DFT and BIST techniques in given electronic design
CO5	Analyze the various fault models
CO6	Analyze IDDQ testing Methods

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2		3	2		1			3		1	1	3	3	3
	CO2		2			3		1		2	1					
	CO3				1	2		1	3		2					
	CO4		3		1		3		1	2		3				
	CO5	3		1	2			2		1			2			
	CO6			2		3			1			3	2			
3	Category	Professional Elective (PE)														
4	Approval	49th Meeting of the Academic Council,														

U18PEEC026	**STATISTICAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital signal processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To Introduce the basics of random signal processing and Concept wise Introduction to Estimation and prediction theory

UNIT I INTRODUCTION TO RANDOM SIGNAL PROCESSING 9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods - Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric method, AR (p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Linear Prediction of Signals-Forward and Backward Predictions, Solution to Prony's normal equation, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters. Linear Minimum Mean-Square Error (LMMSE)

UNIT IV ADAPTIVE FILTERS 9

FIR adaptive filters – adaptive filter based on steepest descent method- Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

UNIT V APPLICATION OVERVIEW-SPEECH PROCESSING 9

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Short-term Fourier transform (STFT): overview of Fourier representation, non-stationary signals, development of STFT, transform and filter-bank views of STFT; Short time Homomorphic Filtering of Speech; Linear Prediction (LP) analysis: Basis and development, Levinson-Durbin's method, normalized error, LPC spectrum.

TEXT BOOK:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002.
2. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition". Pearson Education, 2003.

REFERENCES:

1. Dimitris G. Manolakis and Vinay K .Ingle ,"Applied Digital Signal Processing", Cambridge University Press, 2011.
2. L.R. Rabiner and R.W. Schafer, "Introduction to Digital Speech Processing" (Foundations and Trends in Signal Processing), Now Publishers Inc., USA, 2007.
3. https://nptel.ac.in/content/storage2/courses/117105077/pdf-m-2/m2l9.pdf

COURSE OUTCOMES (COs)	
CO1	Students will analyze the random signal processing
CO2	Students will learn to understand the spectral Estimation
CO3	Students will develop knowledge in Estimation and Prediction theory.
CO4	To know about adaptive filtering and its Applications.
CO5	Understand the fundamentals of Speech
CO6	Understand about speech processing.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	2	3	3			2	3	2	2	2	3	3	3
	CO2	3	2		3					3	3	3				
	CO3	3	2	2	2	2			2	2			2			
	CO4	3	3	2	3	3			2	3		3				
	CO5	3				2			2				1			
	CO6	3	2		2	3				2	2	2	1			
3	Category	Professional Elective (PE)														
4	Approval	49th Meeting of the Academic Council,														

U18PEEC031	**COGNITIVE RADIO**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Analog and Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

Learn the design of the wireless networks based on the cognitive radios
Understand the concepts of wireless networks and next generation networks.

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top-level component interfaces, interface topologies among plug and play modules,.

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, cognitive techniques–position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio- functions, components and design rules, Cognition cycle-orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing , upper layer is sues,cross –layer design.

TEXT BOOK:

1. Joseph Mitola III, ”Software Radio Architecture: Object– Oriented Approaches to Wireless System Engineering”, JohnWiley&SonsLtd.2000.
2. Thomas W.Rondeau, Charles W .Bostain, “Artificial Intelligence in Wireless Communication”, ARTECH HOUSE.2009.
3. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier,2009.
4. Ian F. Akyildiz, Won –Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation/Dynamic spectrum access/cognitive radio wireless networks: A survey “Elsevier Computer Networks, Aug, 2006.

REFERENCES:

1. Simon Haykin, “Cognitive Radio: Brain–Empowered Wireless Communications”, IEEE Journal on selected areas in communications, Feb 2005.
2. Hasari Celebi, Huseyin Arslan, “Enabling Location and Environment Awareness in Cognitive Radios”, Elsevier Computer Communications, Jan 2008.
3. Markus Dillinger, Kambiz Madani , Nancy Alonistioti, “Software Defined Radio”,JohnWiley,2003.
4. Huseyin Arslan,“ Cognitive Radio, SDR and Adaptive System”, Springer, 2007.
5. Alexander M. Wyglinski, Maziar nekovee ,Y. Thomas Hu, “Cognitive Radio Communication and Networks”, Elsevier, 2010
6. www.nptel.ac.in

COURSE OUTCOMES (COs)	
CO1	Describe the basics of the software defined radios.
CO2	To learn the hardware and software architecture of software defined radio
CO3	Design the wireless network based on the cognitive radios.
CO4	Gives an understanding of cognitive radio architecture
CO5	Explain the concepts behind the wireless networks and next generation networks
CO6	To have a better understanding of cognitive techniques

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	1			1			2	1		2		3	3	3
	CO2	2	2	1	1	2			1			2				
	CO3	3	1	2	2	1			2			2	3			
	CO4	3	2	2	1	2			2	1		1				
	CO5	3		1	2	2			2	1		1	3			
	CO6	2			2	1			1	2		2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC032	**ULTRA WIDEBAND COMMUNICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Analog and Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

This course focuses on the basic signal processing techniques that concerns present and future dynamic UWB communication systems.

This course encompasses all areas of design and implementation of UWB systems.

At the end of the semester, the student should be able to develop a comprehensive overview of UWB system design that spans propagation, transmit and receive antenna implementations, standards and advanced topics, modulation and multiple access, network issues, and applications

UNIT I UWB SIGNALS AND SYSTEMS WITH UWB WAVEFORMS 9

Introduction – Power spectral density – Pulse shape – Pulse trains – Spectral masks – Multipath – Penetration characteristics – Spatial and spectral capacities – Speed of data transmission – Gaussian waveforms – Designing waveforms for specific spectral masks – Practical constraints and effects of imperfections.

UNIT II SIGNAL PROCESSING TECHNIQUES FOR UWB SYSTEMS AND UWB CHANNEL MODELING 9

Effects of a lossy medium on a UWB transmitted signal – Time domain analysis – Frequency domain techniques – A simplified UWB multipath channel model – Path loss model – Two-ray UWB propagation model – Frequency domain autoregressive model

UNIT III UWB COMMUNICATIONS AND ADVANCED UWB PULSE GENERATION UWB 9

Modulation methods – Pulse trains – UWB transmitter/receiver – Multiple access techniques in UWB – Capacity of UWB systems – Comparison of UWB with other wideband communication systems – Interference and coexistence of UWB with other systems – Hermite pulses – Orthogonal prolate spheroidal wave functions – Wavelet packets in UWB PSM – Applications of UWB communication systems.

UNIT IV UWB COMMUNICATION STANDARDS AND ADVANCED TOPICS IN UWB COMMUNICATION SYSTEMS UWB 9

Standardization in wireless personal area networks – DS-UWB proposal – MB-OFDM UWB proposal – IEEE proposals for UWB channel models – UWB ad-hoc and sensor networks – MIMO and Space-time coding for UWB systems – Self interference in high data-rate UWB communications – Coexistence of DS-UWB with WIMAX

TEXT BOOK:

1. M. Ghavami, L. B. Michael and R. Kohno, "Ultra Wideband signals and systems in Communication Engineering", 2nd Edition, John Wiley & Sons, NY, USA, 2007.

REFERENCES:

1. Jeffrey H. Reed, "An Introduction to Ultra Wideband Communication systems", Prentice Hall Inc., NJ, USA, 2005.
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/117102062/lec1.pdf

COURSE OUTCOMES (COs)	
CO1	To understand the operational characteristics of UWB
CO2	To study the working principle UWB technologies
CO3	To understand the working concept of all the Blocks Standards of UWB..
CO4	The ability to identify, formulate the radio channel,
CO5	To demonstrate the Wireless OFDM and RFID
CO6	To study the UWB signal characteristics , mask features, fundamentals and standards

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3			2	2			1	1		1		3	3	3
	CO2	2		2	1	1			3	1						
	CO3	2			1	2				2		2				
	CO4	2	3	2	2	1			2	1		1	3			
	CO5	3	2	2	3	1			2			2	3			
	CO6	2			2	1			1	3		2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC033	**BROADBAND NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To understand the basics of networks and to study packet switched networks and circuit switched networks and to study ATM ad optical networks

UNIT I BASIC OF NETWORKS 9

Telephone, computer, cable Television and Wireless network, Networking principles, Digitalization , service integration, network services, and layered Architecture, traffic characterization and QOS, networks services, network elements and network mechanisms

UNIT II PACKET SWITCHED NETWORK 9

CSI and IP models: Ethernet (IEEE 802.3), tokentring(IEEE 802.5) FDDI, QDB, frame relay, SMDS, internet working with SMDS

UNIT III INTERNET AND TCP/IP NETWORKS 9

Interview , internet protocol , TCP and VDP, performance of TCP/IP networks circuit switched networks, SONET , DWDM, Fibre to home ,DSL, Intelligent networks, CATV.

UNIT IV BROAD BAND NETWORK TECHNOLOGY 9

Broadband services, ATM and IP , IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling and policing, throughput, delay and jitter performance.

UNIT V APPLICATIONS 9

MIME, Peer-to-peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session philosophy.

TEXT BOOK:

1. Jean Warland and PravinVaraiya, High Performance Communication Networks, 2nd Edition, Harcourt and Morgan Kauffman , London, 2000
2. Leon Gracia, Widjaja , Communication networks, Tata McGraw Hill, New Delhi. 2000
3. Jon Crowcroft, Mark Handley, Ian Wakeman. Internetworking Multimedia, Harcourt Asia Pvt.Ltd. Singapore, 1998.
4. B.O. Szuprowicz, Multimedia Networking, McGraw Hill, NewYork. 1995

REFERENCES:

1. SumitKasera, Pankaj sethi, ATM Networks, Tata McGraw Hill, New Delhi 2000
2. Behrouz. a. Forouzan ,Data communication and Networking , Tata McGraw Hill, New Delhi,2000.
3. Tay Vaughan, Multimedia making it to work, 4ed,Tata McGrawHill, NewDelhi,2000.
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470434949

COURSE OUTCOMES (COs)	
CO1	To develop skills in networking.
CO2	To gain knowledge in TCP/IP and ISDN concepts.
CO3	To study Internet And Tcp/Ip Networks
CO4	To study packet switched networks and circuit switched networks.
CO5	To study ATM ad optical networks
CO6	To learn about real time applications in broad band networks

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3											2	3	3	3
	CO2		2			2				2			2			
	CO3				3			2								
	CO4	2		1			3		1			1				
	CO5									1	2					
	CO6															
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC034	NETWORK SERVICES	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Computer Network				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

The course gives an introduction to network processors including architecture and how such devices can be used in a system. Additionally, the course looks at how to program Intel IXP network processors and how to use these in a distributed multimedia system

UNIT I INTRODUCTION 9

Traditional protocol processing Systems – Network processing Hardware – Basic Packet Processing Algorithms and data Structures - Packet processing functions – Protocol Software –Hardware Architectures for Protocol processing – Classification and Forwarding– Switching Fabrics.

UNIT II NETWORK PROCESSOR TECHNOLOGY 9

Network Processors: Motivation and purpose - Complexity of Network Processor Design – Network Processor Architectures architectural variety, architectural characteristics Peripheral Chips supporting Network Processors: Storage processors, Classification Processors, Search Engines, Switch Fabrics, Traffic Managers.

UNIT III COMMERCIAL NETWORK PROCESSORS 9

Multi-Chip Pipeline, Augmented RISC processor, Embedded Processor plus Coprocessors Pipelilne of Flomogeneous processors. Configurable Instruction set processors – Pipeline of Electrogeneous processors – Extensive and Diverse processors – Flexible RISC plus Coprocessors – Scalability issues – Design Tradeuffs and consequences.

UNIT IV NETWORK PROCESSOR: ARCHITECTURE ANDPROGRAMMING 9

Architecture: Intel Network Processor: Multiheaded Architecture Overview – Features-Embedded EISC processor - Packet Processor Hardware – Memory interfaces – System and Control Interface Components – Bus Interface. Programming Software Development Kit-IXP Instruction set –register formats – Micro Engine Programming – Intra thread and Inter-thread communication –thread synchronization – developing sample applications – control plane – ARM programming.

UNIT V IOS TECHNOLOGIES 9

CISCO COS – Connectivity and scalability – high availability – IP routing – IP services – IPV6 –Mobile IP – MPLS – IP Multicast 0 Manageability – QoS – Security – Switching – Layer VPN2.

TEXT BOOK:

1. Douglas E.Comer “Networks Systems Design using Network Processors” Prentice Hall Jan 2003.
2. Panas C. Lekkas, “Network Processors: Architectures, Protocols and Paradigms Telecom Engineering)”, McGraw Hill, Professional, 2003.
3. Patrick Crowley, M aEranklin, H. Hadminglu, PZ Onfryk, “Network Processor Design, Issues and Practices Vol-1” Morgan Kaufman, 2002.

REFERENCES:

1. Patrick Crowley, M a Frankliln, H. Hadimioglyum PZ Onufryk, Network Processor Design,. Issues and Prentices vol.II, Morgan Kaufman, 2003.

2. Erik, J.Johnson and Aaron R.Kunze, "IXP2400/2806 Programming: The Microengine Coding Grade" Intel Press.
3. https://en.wikipedia.org/wiki/Network_service

COURSE OUTCOMES (COs)	
CO1	Understand network processing hardware.
CO2	Understand network processors and classification of processors.
CO3	Understand Embedded processors and coprocessors and pipelining.
CO4	Explore network processor architecture and programming.
CO5	Understand IP routing and IP services.
CO6	Understand the Quality of service and security.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	3	3	3		3	3	3
	CO2	2	3	3	2	2			2	3	3	3				
	CO3	2	3	3	2	2			2	3	3	3				
	CO4	2	3	3	2	2			2	3	3	3	3			
	CO5	2	3	3	2	2			2	3	3	3				
	CO6	2	3	3	2	2			2	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC035	**IOT AND MACHINE LEARNING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Embedded System				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To Understand the Architectural Overview of IoT
To Understand the IoT Reference Architecture and real World Design Constraints.
To Understand about cloud systems and sensors in IoT
To Understand the various learning algorithms and the applications of IoT

UNIT I OVERVIEW 9

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

UNIT II IOT SMART SENSORS 9

Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas, etc., Important Characteristics of Sensors Importance and Adoption of Smart Sensors Architecture of Smart Sensors Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel

UNIT III IOT CLOUD SYSTEMS 9

The Cloud -Hype cycle-metaphorical interpretation-cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, role of virtualization in enabling the cloud.

UNIT IV LEARNING ALGORITHMS IN IOT 9

Regression Algorithms-Linear Regression- Polynomial Regression-Recurrent Neural Networks-Long Short term Memory Networks-Logistic Regression-Support Vector machines-Anomaly Detection-Python Programming

UNIT V CASE STUDIES 9

Design and Implementation of IoT for Environmental Condition Monitoring Case study: Development of WSN Based Smart Bed for Health Care Application Case study: Study of Smart City and its Design Case study: Study of Smart Airport and its Design Relevance of IoT to Developing World and Research Scope for the Internet of things

TEXT BOOK:

1. Vijay Madisetti, Arshdeep Bahga," Internet of Things A Hands-On- Approach",2014, ISBN:978 0996025515.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
3. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).

REFERENCES:

1. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013, ISBN: 978-1-118-43062-0 2. Daniel Kellmereit, "The Silent Intelligence: The Internet of Things". 2013, ISBN 0989973700.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. https://www.coursera.org/learn/machine-learning
4. https://www.leverege.com/blogpost/machine-learning-applications-in-iot

COURSE OUTCOMES (COs)	
CO1	Able to understand the design principles of IoT
CO2	To learn about the architecture of IoT
CO3	Able to realize the concepts of IoT smart sensors
CO4	Able to understand the importance of cloud systems
CO5	To develop knowledge about the learning algorithms in IoT
CO6	To learn about the applications of IoT

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2			2	3			2	2				3	3	3
	CO2	2	2	3	2	3			2	2			3			
	CO3	2	3	3	3	3			3	3	3	3	3			
	CO4	2	3	3	3	3			3	3	3	3	3			

	CO5	3	3	3	3	3			3	3	3	3	3			
	CO6	2	3	3	3	3			3	3	3	3	3			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC036	SYSTEM MODELING & DESIGN	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Analog & Digital Communication and Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To enable the student to understand the various aspects of simulation methodology and performance, appreciate the significance of selecting sampling frequency and modeling different types of signals and processing them

UNIT I SIMULATION METHODOLOGY 9

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for band pass signals, Multicarrier signals, Non-linear and time varying systems, Post processing – Basic graphical techniques and estimations.

UNIT II RANDOM SIGNAL GENERATION & PROCESSING 9

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

UNIT III MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT IV ADVANCED MODELS & SIMULATION TECHNIQUES 9

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modelling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.

UNIT V EFFICIENT SIMULATION TECHNIQUES 9

Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

TEXT BOOK:

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.
2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001.

REFERENCES:

1. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000.

2. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992.
3. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.
4. https://cs.ccsu.edu/~stan/classes/CS410/Notes16/05-SystemModeling.html

COURSE OUTCOMES (COs)	
CO1	The student would be able to mathematically model a physical phenomena
CO2	To simulate the phenomena to depict the characteristics that Aug be observed in a real experiment
CO3	The student would be able to apply his knowledge of the different simulation techniques for designing a communication system or channel
CO4	To show the performance so as to match a realistic scenario.
CO5	To expose the student to the different simulation techniques, their pros and cons
CO6	To enable him to understand and interpret results using case studies

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	2	3	2	2			1	2	2	2		3	3	3
	CO2	2	3	3	2	2			2	1		2	3			
	CO3	3	2	3	2	1			2	1	3	2	3			
	CO4	2	3	2	2	1			2	2		1	3			
	CO5	3	2	3	1	3			2	1	3	2	3			
	CO6	3	2	2	2	3			2	1	1	2	3			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC037	**ADAPTIVE SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital signal processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

Introduction to the various techniques used to predict the outcomes of a random Process.
Ability to appreciate the various filters, their inherent assumptions and the statistics they require.
Top-level understanding of the convergence issues, computational complexities and optimality of different filters.
Ability to develop adaptive systems for various applications.

UNIT I ADAPTIVE SYSTEMS 9

Definitions and characteristics - applications – properties-examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction - linear optimum filtering-orthogonality - Wiener – Hop equation-performance surface.

UNIT II STABILITY AND RATE OF CONVERGENCE 9

Learning curve-gradient search - Newton's method - method of steepest descent - comparison - Gradient estimation - performance penalty - variance - excess MSE and time constants – mis-adjustments.

UNIT III LMS ALGORITHM CONVERGENCE OF WEIGHT VECTOR 9

LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals.

UNIT IV INVERSE ADAPTIVE MODELING 9

Equalization, and de-convolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis.

UNIT V APPLICATIONS 9

Adaptive Modeling and System Identification, Multipath communication channel, geophysical exploration, FIR digital filter synthesis.

TEXT BOOK:

1. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive Filters", Prentice-Hall of India, 2002
2. S. Thomas Alexander, "Adaptive Signal Processing - Theory and Application", Springer-Verlag

.

REFERENCES:

1. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Person Education, 2005.
2. Simon Haykin, "Adaptive Filter Theory", Pearson Education, 2003.
3. D. G. Manolokis, V. K. Ingle and S. M. Kogar, "Statistical and Adaptive Signal Processing", Mc Graw Hill International Edition,2000.
4. https://nptel.ac.in/courses/117105075/

COURSE OUTCOMES (COs)																
CO1	To learn about adaptive systems															
CO2	To analyse about stability and rate of convergence															
CO3	To analyze about LMS algorithm.															
CO4	To Analyze and implement recursive filters.															
CO5	To analyze about inverse adaptive modeling															
CO6	To apply adaptive signal processing to various applications.															
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low																
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3		2	3	2			3					3	3	3
	CO2	3	2	2	2					3	3		3			
	CO3	3			2	2						2	3			
	CO4	3	3			2					2		3			
	CO5	3	2	2					3				3			
	CO6	3			3	2			2	3	2	3	3			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC041	CRYTOGRAPHY AND NETWORK SECURITY	L	T	P	C
	Total Contact Hours-45	3	0	0	3
	Prerequisite: Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

The student should be made to:

Understand OSI security architecture and classical encryption techniques.

Acquire fundamental knowledge on the concepts of finite fields and number theory.

Understand various block cipher and stream cipher models.

Describe the principles of public key cryptosystems, hash functions and digital signature.

UNIT I INTRODUCTION & NUMBER THEORY 10

Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid‟s algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat‟s and Euler‟s theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

UNIT II BLOCK CIPHERS & PUBLIC KEY CRYPTOGRAPHY 10

Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. **Public key cryptography:** Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT III HASH FUNCTIONS AND DIGITAL SIGNATURES 8

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – EI Gamal – Schnorr.

UNIT IV SECURITY PRACTICE & SYSTEM SECURITY 8

Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

UNIT V E-MAIL, IP & WEB SECURITY 9

E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source-Message Integrity-Non-Repudiation-Pretty Good Privacy-S/MIME. **IP Security:** Overview of IPSec - IP and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). **Web Security:** SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSLAttacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).

TEXT BOOK:

1. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013. (UNIT I,II,III,IV).

2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002.(UNIT V).

REFERENCES:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill, 2007.
2. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
3. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.
5. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security, Second Edition, Private Communication in Public World", PHI 2002.
6. Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
7. Douglas R Simson "Cryptography – Theory and practice", First Edition, CRC Press, 1995.
8. http://nptel.ac.in/.

COURSE OUTCOMES (COs)	
CO1	Able to Compare various Cryptographic Technique.
CO2	Design Secure applications
CO3	Understand Inject secure coding in the developed applications
CO4	Explore Security of Hash function and MAC.
CO5	Understand Firewall related terminology and Types of Firewall.
CO6	Understand the concepts of web security and IP security.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	3	3	3		3	3	3
	CO2	2	3	3	2	2			2	3	3	3	3			
	CO3	2	3	3	2	2			2	3	3	3	3			
	CO4	2	3	3	2	2			2	3	3	3	3			
	CO5	2	3	3	2	2			2	3	3	3				
	CO6	2	3	3	2	2			2	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC042	**ROUTING PROTOCOLS**	**L**	**T**	**P**	**C**
	Total Contact Hours-45	3	0	0	3
	Prerequisite: Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

Obtain a broad understanding about the routing protocol; it specifies how routers communicate with each other, distributing information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route. Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network

UNIT I INTRODUCTION TO ROUTING AND PACKET FORWARDING 9

Inside the Router, CLI Configuration and Addressing, Building the Routing Table, Path Determination and Switching Functions.

UNIT II ROUTING TABLE 9

The Routing Table Structure, Routing Table Lookup Process, Routing Behavior

UNIT III STATIC ROUTING PROTOCOLS 9

Routers and the Network, Router Configuration Review, Exploring Directly Connected Networks, Static Routes with "Next-Hop" Addresses, Static Routes with Exit Interfaces, Managing and Troubleshooting Static Routes

UNIT IV DYNAMIC ROUTING PROTOCOLS 9

Introduction to Dynamic Routing Protocols , Classifying Dynamic Routing Protocols, Distance Vector Routing Protocols, Link-State Routing Protocols.

UNIT V ROUTING INFORMATION PROTOCOL 9

Basic RIPv1 Configuration, Basic RIPv2 Configuration, Verification and Troubleshooting, Automatic Summarization.

TEXT BOOK

1. Routing Protocols and Concepts CCNA Exploration Companion Guide, Rick Graziani, Allan Johnson, Copyright© 2008 Cisco Systems, Inc. Published by: Cisco Press 800 East 96th Street Indianapolis, IN 46240 USA.

REFERENCES:

1. IP Routing Protocols, by Uyless Black, Publisher: Prentice Hall *Release Date: February 2000*, ISBN: 0130142484
2. C S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India, 2nd ed. 2005.
3. R. Hekmat, Ad hoc Networks: Fundamental Properties and Network Topologies, Springer, 1st ed. 2006.
4. http://osnet.cs.nchu.edu.tw/powpoint/Computer%20Network93_1/Chapter%2013.pdf

COURSE OUTCOMES (COs)	
CO1	Understand the basics of Routing and Packet Forwarding
CO2	Understand about the details and structure of Routing Table
CO3	Understand about the Static Routing Protocols and its types
CO4	Understand about the Dynamic Routing Protocols and its types
CO5	Understand about the Routing Information Protocol version 1
CO6	Understand about the Routing Information Protocol version 2

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2	1		2	3	3	3	1	3	3	3
	CO2	2	3	3	2	2	1		2	3	3	3	1			
	CO3	2	3	3	2	2	1		2	3	3	3	1			
	CO4	2	3	3	2	2	1		2	3	3	3	1			
	CO5	2	3	3	2	2	1		2	3	3	3	1			
	CO6	2	3	3	2	2	1		2	3	3	3	1			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC043	ROBOTICS AND AUTOMATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Microcontroller				
	Department:- Dept. of Electronics and Communication Engineering.				

To study the various parts of robots and fields of robotics
To study the various kinematics and inverse kinematics of robots
To study the Euler, Lagrangian formulation of Robot dynamics
To study the trajectory planning for robot.
To study the control of robots for some specific applications

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – various generations of robots - Asimov's laws of robotics - robot anatomy – robot configuration, robot motions and degrees of freedom –control system of a robot - types of robot control – performance measures – stability, resolution, accuracy, repeatability and compliance of robot

UNIT II SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the tactile sensors – touch sensors, force and torque sensors – non tactile sensors – light/ fiber optic sensor, laser sensor, acoustic, magnetic sensor – machine vision: model, sensing and digitizing, image processing and analysis, applications of machine vision in robotics.

UNIT III DRIVES, MANIPULATORS AND GRIPPERS 9

Hydraulic, pneumatic and electric drive systems – gears – Construction of manipulators – manipulator dynamics and force control – grippers – mechanical, vacuum and magnetic grippers design considerations.

UNIT IV KINEMATICS AND PROGRAMMING 9

Robot kinematics and Solution of inverse kinematics problem - Robot programming methods – lead through programming method: program as path in space, commands, program for pick and place operation – textual programming method: language structure, elements and functions languages

UNIT V CASE STUDIES 9

Multiple robots and machine interface – robot cell layout/ work cell, work cell design consideration, work cell controller – Robots in manufacturing applications, robots in nonmanufacturing applications - selection of robot.

TEXT BOOK::

1. M.P.Groover, Mitchell Weiss, R.N Nagel, N.G Odrey, "Industrial Robotics – Technology, Programming and Applications",McGraw-Hill, 2008
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCES:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. http://engineering.nyu.edu/mechatronics/smart/pdf/Intro2Robotics.pdf

COURSE OUTCOMES (COs)	
CO1	To study the various parts of robots and fields of robotics
CO2	To study the various kinematics and inverse kinematics of robots
CO3	To study the Euler, Lagrangian formulation of Robot dynamics
CO4	To study the trajectory planning for robot.
CO5	To study the control of robots for some specific applications
CO6	To study the various parts of robots and fields of robotics

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3		1	3		2	1				1	2	3	3	3
	CO2		3		1	3			2		2	1	2			
	CO3				3	2		1	2			3	2			
	CO4		3		1		3		1	2		3	2			
	CO5	2			3			2		1			2			
	CO6			2		1			3		2		2			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC044	NANO ELECTRONICS	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Semiconductor Physics				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To learn and understand basic concepts of Nano electronics.
To know the techniques of fabrication and measurement.
To gain knowledge about Nanostructure devices and logic devices

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Background to nanotechnology: Types of nanotechnology and nanomachines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space – top down and bottom up; Molecular Nanotechnology: Electron microscope – scanning electron microscope – atomic force microscope – scanning tunnelling microscope – nano manipulator – nano tweezers – atom manipulation– nanodots – self assembly – dip pen nanolithography. Nano materials: preparation –plasma arcing – chemical vapor deposition – sol-gels – electro deposition – ball milling –applications of nanomaterials.

UNIT II FUNDAMENTALS OF NANOELECTRONICS 9

Fundamentals of logic devices:- Requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation: - power dissipation limit – dissipation in reversible computation – the ultimate computer.

UNIT III SILICON MOSFETs & QUANTUM TRANSPORT DEVICES 9

Silicon MOSFETS - Novel materials and alternate concepts: - fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: - Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applications: - Single electron devices – applications of single electron devices to logic circuits.

UNIT IV CARBON NANOTUBES 9

Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs –Nanotube for memory applications – prospects of an all carbon nanotube nanoelectronics.

UNIT V MOLECULAR ELECTRONICS 9

Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices.

TEXTBOOKS:

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard
2. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman &Hall / CRC, 2002
3. T. Pradeep, NANO: The Essentials – Understanding Nanoscience and Nanotechnology, TMH, 2007
4. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003
5. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press 2011.
6. Supriyo Datta,“Lessons from Nanoelectronics: A New Perspective on Transport”, World Scientific2012

REFERENCES:

1. Mircea Dragoman, Daniela Dragoman, “Nanoelectronics: principles and devices”, CRC Press 2006.
2. Karl Goser, Peter Glösekötter, Jan Dienstuhl,“Nanoelectronics and Nano systems: From Transistors to Molecular and Quantum Devices“, Springer 2004
3. W. R. Fahrner, Nanotechnology and Nan electronics: Materials, Devices, Measurement Techniques (Springer Verlag Berlin Heidelberg 2005)
4. Mark A. Reed, Takhee Lee,“ Molecular nanoelectronics”, American Scientific Publishers 2003
5. Jaap Hoekstra, “Introduction to Nano electronic Single-Electron Circuit Design”, Pan Stanford Publishing 2010
6. W. Ranier, “Nano Electronics and Information Technology”, John Wiley & Sons 2012.
7. https://nptel.ac.in/courses/117108047/

COURSE OUTCOMES (COs)	
CO1	Students will understand about nano technology and nano machines.
CO2	Students will have in-depth technical knowledge about logic devices,their properties and their performance

CO3	Students will learn about silicon MOSFET and advanced MOSFET Concepts
CO4	Students will develop deep knowledge about quantum transport devices
CO5	Students will learn about carbon nano tubes.
CO6	Students will learn about the concepts related to molecular electronics.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	3	3	3		3	3	3
	CO2	3	2	3	2	2										
	CO3	3	2	3	3	3			3	2	3	2				
	CO4	3									2					
	CO5	3								2						
	CO6	3		3	3	3			3	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC045	**WAVELETS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital signal processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To study the basics of signal representation and Fourier theory.
To understand Multi Resolution Analysis and Wavelet concepts
To study the wavelet transform in both continuous and discrete domain
To understand the design of wavelets using Lifting scheme
To understand the applications of Wavelet transform

UNIT I FUNDAMENTALS 9

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT II MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) –Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.

UNIT III CONTINUOUS WAVELET TRANSFORMS 9

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies , Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.

UNIT IV DISCRETE WAVELET TRANSFORM 9

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT –Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.

UNIT V APPLICATIONS 9

Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding– Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions –Edge Detection and Object Isolation, Image Fusion, and Object Detection.

TEXT BOOK:

1. Rao R M and A S Bopardikar, ―Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

REFERENCES:

1. J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" Wiley Interscience Publication,John Wiley & Sons Inc., 1999.
2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.
3. Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.
4. Soman K P and Ramachandran K I, ―Insight into Wavelets From Theory to practice, Prentice Hall, 2004.
5. https://www.springer.com/gp/book/9783319594323

COURSE OUTCOMES (COs)	
CO1	Understand time-frequency nature of the signals.
CO2	Apply the concept of wavelets to practical problems.
CO3	Mathematically analyze the systems or process the signals using appropriate wavelet functions.
CO4	Gain knowledge about MRA and representation using wavelet bases.
CO5	Acquire knowledge about various wavelet transforms and design wavelet transform
CO6	Apply wavelet transform for various signal & image processing applications.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3									3	3	3
	CO2	3	3	2	2	2	2			2	3		3			
	CO3	3	3	2	2	2					3	3	3			
	CO4	3	3				3			2		3				
	CO5	3	3	3	3		3			3		3	3			
	CO6	3	3	3	3	3	3			3	3		3			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC046	PATTERN RECOGNITION AND NEURAL NETWORKS	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Digital Signal Processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

The course provides a comprehensive foundation to Artificial Neural Networks with applications to Pattern Recognition and Data Mining. Learning processes: supervised and unsupervised, deterministic and statistical.

UNIT I INTRODUCTION AND SIMPLE NEURAL NET WORK 9

Elementary neurophysiology and biological neural network-Artificial neural network – Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT II BACK PROPOGATION AND ASSOCIATIVE MEMORY 9

Back propogation network, generalized delta rule, Bidirectional Associative memory, Hopefield network.

UNIT III NEURAL NETWORKS BASED ON COMPETITION 9

Korhonen Self organizing map, Learning Vector Quantization, counter propagation network.

UNIT IV UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9

Patterns and features, training and learning in pattern recognition, discriminant functions, different types of pattern recognition. Unsupervised learning- hierarchical clustering, partitional clustering. Neural pattern recognition approach – perceptron model.

UNIT V SUPERVISED LEARNING USING PARAMETRIC AND NON-PARAMETRIC APPROACH 9

Bayesian classifier, non-parametric density estimation, histograms, kernels, window estimators, k-nearest neighbor classifier, estimation of error rates.

TEXT BOOK:

1. B. D. Ripley: “Pattern Recognition and Neural Networks”, Cambridge University Press, Cambridge, UK, 1996.
2. K. Fukunaga: “Introduction to Statistical Pattern Recognition”, Academic Press, San Diego, CA, 1990.
3. S. Haykin: Neural Networks: A Comprehensive Foundation, second Edition, 1999.
4. www.vidyarthiplus.com

REFERENCES:

1. C. M. Bishop: “Neural Networks for Pattern Recognition”, Oxford University Press, Oxford, UK, 1995.
2. H. A. Bourlard, N. Morgan: “Connectionist Speech Recognition”, Kluwer Academic Publishers, Boston, MA, 1994
3. R. O. Duda, P. E. Hart, D. G. Stork: “Pattern Classification” 2nd ed., J. Wiley & Sons, New York, NY, 2001
4. https://www.vidyarthiplus.com/vp/Thread-BM2401-Pattern-Recognition-and-Neural-Networks-Lecture-Notes-All-Units#.XagPHZIzbIU

COURSE OUTCOMES (COs)	
CO1	To understand the basics of Neural Network and Architecture

CO2	To gain knowledge about back propagation and associative memory
CO3	To provide knowledge of self self-organizing
CO4	To understand different types of pattern recognition
CO5	To understand and apply both supervised classification methods to detect and characterize patterns in real-world data
CO6	To provide knowledge of learning and adaptation in supervised modes of learning

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	1	2	2	1			2	1		2		3	3	3
	CO2	2		2	1				1	1		2				
	CO3	2		2	1	2			1	2		1				
	CO4	2	1	2	2	2			1	1		2				
	CO5	2		1	2	1			2	1		1				
	CO6	2		1	2	1			1	2		2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC051	**SATELLITE COMMUNICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Electromagnetic Waves & Analog& Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To enable the student to become familiar with satellites and satellite services.
Study of satellite orbits and launching.
Study of earth segment and space segment components
Study of satellite access by various users

UNIT I INTRODUCTION 9

Introduction, Types – Active and Passive Satellite, Frequency allocation, Satellite orbits, Kepler's laws, Definitions of terms for earth-orbiting Satellites, Apogee and Perigee heights, Orbit Perturbations, Geo stationary orbit, Antenna look angles, Limits of visibility, Earth Eclipse of Satellite, Sun transit outage, launching orbits.

UNIT II THE SPACE SEGMENT 9

Introduction, The Power supply, Attitude control, spinning satellite, stabilization, Momentum Wheel Stabilization, Station keeping, Thermal control, TT&C subsystem, Transponders, The Wide Band receiver, The Input Demultiplexer, The Power Amplifier, The Antenna subsystem.

UNIT III THE EARTH SEGMENT AND ANTENNAS 9

Transmit receive earth station subsystems, up-converters-High Power Amplifier-Receive chain-LNA&LNB.TVRO earth station, The isotropic radiator and antenna gain, Horn antenna, The Parabolic reflector, Double reflector antenna-Cassie grain antenna-Gregorian antenna.

UNIT IV THE SPACE LINK & SATELLITE ACCESS 9

EIRP, Transmission losses The Link budget equation, System noise, Effects of rain, up link and down link C/N ratio. Multiple access techniques-Concepts and types of TDMA, FDMA and CDMA-Comparison and contrast of TDMA, FDMA and CDMA.

UNIT V SATELLITE APPPLICATIONS **9**

Satellite Mobile services, DBS, VSAT, Remote sensing, GPS, INTELSAT, INMARSAT, SARSAT, Video Conferencing and Internet connectivity

TEXT BOOK:

1. Dennis Roddy, "Satellite Communication", 4th Edition,McGrawHill International,2006.

REFERENCES:

1. Wilbur L.Pritchard, Hendri G.Suyderhoud,Robert A.Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N.Agarwal,"Design of Geosynchronous Space Craft", Prentice Hall,1986.
3. BruceR.Elbert,"TheSatelliteCommunicationApplications",HandBook,ArtechHouseBosta n London,1997.
4. TriT. Ha, "Digital Satellite Communication", IInd Edition,1990.
5. Emanuel F Thenakis, "Manual of Satellite Communications", McGraw Hill Book Co.,1984.
6. Robert G.Winch, "Telecommunication Transmission Systems",McGraw-Hill Book Co., 1983.
7. BrianAckroyd,"WorldSatelliteCommunicationandEarthStationDesign",BSP Professional Books,1990.
8. G.B.Bleazard,"Introducing Satellite communications", NCC Publication,1985
9. https://lecturenotes.in/notes/1654-notes-for-satellite-communication-system-scs-by-bhagyalaxmi-jena

COURSE OUTCOMES (COs)	
CO1	Define orbital mechanics and launch methodologies
CO2	Describe satellite subsystems
CO3	Design link power budget for satellites
CO4	Compare competitive satellite services
CO5	Explain satellite access techniques
CO6	DTH and compression standards

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	2	1	2			1		1	2	2	3	3	3
	CO2	3	2	3	1	2			2			2	2			
	CO3	2	2	3	2	1			2		1	1	2			
	CO4	2			1	2			3		1		2			
	CO5	2	1	2	2	1			2			3	2			
	CO6	2			2	1			2			2	2			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC052	**HIGH PERFORMANCE COMMUNICATION NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours-45	3	0	0	3
	Prerequisite: Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To Provide the various high speed digital access and broadband technologies, Switching techniques used for communication, Congestion control Performance issues and quality of service required for better performance of high speed networks and focuses how networking research is done.

UNIT I BASIC OF NETWORKS 9

Telephone, computer, cable Television and Wireless network, Networking principles, Digitalization , service integration, network services, and layered Architecture, traffic characterization and QOS, networks services, network elements and network mechanisms.

UNIT II PACKET SWITCHED NETWORK 9

CSI and IP models: Ethernet (IEEE 802.3), tokentring(IEEE 802.5) FDDI, QDB, frame relay, SMDS, internet working with SMDS.

UNIT III INTERNET AND TCP/IP NETWORKS 9

Interview , internet protocol , TCP and VDP, performance of TCP/IP networks circuit switched networks, SONET , DWDM, Fiber to home ,DSL, Intelligent networks, CATV.

UNIT IV ATM AND WIRELESS NETWORKS 9

Main features- addressing, signaling and routing , ATM header structure- adaptation layer, management and control, BISDN, Interworking with ATM, Wireless channel, link level design, channel access, Network design and wireless networks.

UNIT V OPTICAL NETWORKS AND SWITCHING 9

Optical links- WDM systems, cross –connects, optical LAN'S, optical paths and networks, TDS and SDS, modular switch designs- packet switching, distributed, shared, input and output buffers.

TEXT BOOK:

1. Jean Warland and Pravin Varaiya, High Performance Communication Networks, 2nd Edition, Harcourt and Morgan Kauffman, London, 2000
2. Leon Gracia, Widjaja , Communication networks, Tata McGraw Hill, New Delhi. 2000.

REFERENCES:

1. Sumit Kasera, Pankaj sethi, ATM Networks, Tata McGraw Hill, New Delhi 2000
2. Behrouz. a. Forouzan ,Data communication and Networking , Tata McGraw Hill, New Delhi,2000
3. https://www.elsevier.com/books/high-performance-communication-networks/walrand/978-0-08-050803-0

COURSE OUTCOMES (COs)	
CO1	Understand about basics of network.
CO2	Gain knowledge in TCP/IP and ISDN concepts.
CO3	Understand about Internet and Tcp/Ip Networks
CO4	Understand about packet switched networks and circuit switched networks
CO5	Understand about ATM and optical networks
CO6	Understand different networking and switching design
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low	

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	3	3	3		3	3	3
	CO2	2	3	3	2	2			2	3	3	3				
	CO3	2	3	3	2	2			2	3	3	3				
	CO4	2	3	3	2	2			2	3	3	3				
	CO5	2	3	3	2	2			2	3	3	3				
	CO6	2	3	3	2	2			2	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC053	REAL TIME SYSTEMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Embedded systems				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To expose the students to the fundamentals of Real Time systems
To teach the fundamentals of Scheduling and features of programming languages
To study the data management system for real time
To introduce the fundamentals of real time communication
To teach the different algorithms and techniques used for real time systems

UNIT I INTRODUCTION 9

Introduction – issues in real time computing – structure of a real time system – task glasses – performances measures for real time systems – estimating program run time – task assignment and scheduling – classical uniprocessor scheduling algorithms – uniprocessor scheduling of IRIS tasks – tasks assignment – mode changes – fault tolerant scheduling.

UNIT II PROGRAMMING LANGUAGES AND TOOLS 9

Language features – desired language characteristics – data typing – control structure – facilitating hierarchical decomposition – package – run – lime error handling – overloading and generics – multi tasking – low-level programming – task scheduling – lining specifications – programming environment – run-time support – code generation.

UNIT III REAL TIME DATA BASES 9

Real time data base- basic definition – real lime vs general – purpose database – main memory data bases – transaction priorities – transaction aborts – concurrent control issues –disk scheduling algorithms – two-phase approach to improve predictability – maintaining serialization consistency- databases for hard real time systems.

UNIT IV COMMUNICATION 9

Real time communication – communications media – network topologies – protocols – buffering data – synchronization – deadlock – mailboxes and semaphores – fault tolerance techniques – fault types – fault detection – fault error containment – redundancy – data diversity – reversal checks – integrated handling.

UNIT V EVALUATIION TECHNIQUES 9

Reliability evaluation techniques – reliability models for hardware redundancy – software error models – response time calculations – interrupt latency – time loading and its measurement –

reducing response times – latency – time loading and its measurement – reducing response times – analysis of memory requirements – reducing memory loading.

TEXT BOOK

1. C.M Krishna, kangG.shin, real- time systems, McGraw-hill international editions, 1997.

REFERENCES:

1. Straut Bennett, real time computer control – an introduction, PHI, 1998.
2. Peter D Lawrence, real time micro computer system design – an introduction, McGraw hill, 1998.
3. S.T allworth and R.N Zobel, introduction to real time software design macmillan, 2nd edition, 1987.
4. www.rts.org/rassp/vhdl/guidelines/**Design**Req.pdf

COURSE OUTCOMES (COs)	
CO1	Explain and apply the fundamental concepts and terminology of real-time systems.
CO2	Explain and address the fundamental problems of real-time systems
CO3	Analyze real-time systems designs
CO4	Design a real-time system (at least partially)
CO5	Identify and assess the relevant literature and research trends of real-time systems.
CO6	Analyze the programming languages of real time systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1			3	2					2		3	3	3	3	3
	CO2	3	2	2		3	3				3	1	3			
	CO3				3	1			3	1		2	3			
	CO4		3	1		2	1	3		2		3	3			
	CO5	2											3			
	CO6		3			2				2			3			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC054	**DIGITAL HARDWARE DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital System Design				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To study the applications of logic gates.
To use K-maps for digital circuit design.
To study and understand basics of microprocessors
To understand fundamentals of multicore technology

UNIT I DIGITAL CIRCUIT DESIGN 9

Introduction to digital circuit design, Circuit design using logic gates: Binary to gray converter, Gray to Binary converter, Decimal to BCD encoder, Circuit designusing state table/K-map: Design of Full adder, full subtractor, BCD to seven segment decoder, Concept of excitation table, Design of 3 bit synchronous up counter , 3 bit random sequence generator .

UNIT II MEMORY 9

Memory Architecture, Memory Hierarchy, Introduction to USB storage device, Memory parameters (Access time, speed, capacity, cost), Vertical & horizontal Memory expansion (increasing the capacity, increasing word size), Associative Memory, Cache memory, cache mapping techniques, virtual memory, virtual memory mapping (paging and segmentation).

UNIT III COMPUTER ORGANIZATION 9

Concept of Address Bus, Data Bus, Control Bus. Register based CPU organization, stack organization, I/O organization: need of interface, block diagram of general I/O interface. Working concepts like polling, interrupt initiated data transfer. Concept of DMA , DMA transfer, DMA Controller Serial communication: Synchronous, asynchronous and their data transmission formats, RS–232, General block diagram of UART.

UNIT IV MICROPROCESSOR 9

Evolution of Microprocessor (8086 to Pentium 4), Features like address, data, bus size, speed, cache capacity, number of parallel instructions executed. Concept of RISC & CISC, Von-Neumann & Harvard Architecture, Concept of pipeline.

UNIT V ARCHITECTURE OF BASIC MICROPROCESSOR 9

Architecture of basic microprocessor: 8086 & Pentium (Basic Version), Introduction to multicore processors, its development and impact on Hardware, Software.

TEXT BOOK:

1. Fundamental of Digital electronics : R.P. Jain ,
2. Digital design : M. Morris Mano, Prentice-Hall of India
3. Computer System Architecture : Morris Mano, Prentice-Hall of India

REFERENCES:

1. The Pentium Microprocessor : James Antonakos
2. Microprocessors and Interfacing Programming and Hardware: Douglas V. Hall- TATA McGraw-Hill Edition
3. The Intel Microprocessors : Barry B. Brey- Pearson Education Asia.
4. https://www.academia.edu/34906578/Digital_Hardware_Design.pdf

COURSE OUTCOMES (COs)	
CO1	To lay a strong foundation to understand the concepts in Digital circuit design.
CO2	To learn about Memories
CO3	To gain knowledge about computer organization
CO4	To understand about serial communication
CO5	To understand the basics of microprocessor
CO6	To understand about multi core processor.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS
2	CO1	3	3	3	2	2			2	2		2		3	3	3
	CO2	3		3	2				2	3	2					
	CO3	2		2		2					2					
	CO4	2	3	2	2	2			2			2				
	CO5	2	3	3	3					2						
	CO6	2	3	3	3				2	2	2	2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC055	MEDICAL IMAGE PROCESSING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Digital Signal Processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

This course provides in depth knowledge about the various digital image processing techniques applied in processing of the medical images

UNIT I IMAGE FUNDAMENTALS 9

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT II IMAGE PREPROCESSING 9

Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations, Image restoration – Image degradation model, Inverse and Weiner filtering. Image Compression – Spatial and Transform methods .

UNIT III MEDICAL IMAGE RECONSTRUCTION 9

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, FMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear Medicine Imaging Modalities SPECT,PET, Molecular Imaging.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image fusion, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TEXT BOOK:

1. Atam P.Dhawan, 'Medical Image Analysis', Wiley Interscience Publication, NJ, USA 2003.
2. R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education, 2002.
3. Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint 2003.

REFERENCES:

1. Alfred Horowitz, 'MRI Physics for Radiologists – A Visual Approach', Second edition Springer Verlag Network, 1991.
2. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006
3. John L.Semmlow,"Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
4. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006 5.. Geoff Dougherty, "Digital Image Processing for Medical Apllications," Cambridge University Press,India 2009

5. http://ultra.sdk.free.fr/docs/DxO/Digital%20Image%20Processing%20for%20Medical%20Applications.pdf

COURSE OUTCOMES (COs)	
CO1	To study the image fundamentals and image transforms
CO2	To study the image enhancement techniques
CO3	To understand about reconstruction methods related to medical images
CO4	To study the image segmentation and image analysis
CO5	To study the image registration procedures
CO6	To learn about image visualization techniques

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	3	3			3	2	2	3		3	3	3
	CO2	3	3	3	3	3			3	2	2	3				
	CO3	2	3	3	2	3			2	2	2	3				
	CO4	2	3	3	2	3			3	2	2	3				
	CO5	2	3	3	3	3			2	2	2	3				
	CO6	2	3	3	3	3			2	2	2	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC056	DIGITAL IMAGE & VIDEO PROCESSING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Digital signal processing				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

This course will cover the fundamentals of image and video processing.
Students will gain knowledge to understand about algorithm design, mathematical tools, and practical implementations of various digital image & video applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS 9

Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT II IMAGE PROCESSING TECHNIQUES 9

Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

UNIT III IMAGE COMPRESSION 9

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding,

run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.

UNIT IV BASIC STEPS OF VIDEO PROCESSING 9

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.

UNIT V 2-D MOTION ESTIMATION 9

Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

TEXT BOOK:

1. Gonzaleze and Woods ,"Digital Image Processing ", 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI .
3. 1.M. Tekalp ,"Digital video Processing", Prentice Hall International

REFERENCES:

1. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
2. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons
3. Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons.
4. https://nptel.ac.in/courses/117105079/

COURSE OUTCOMES (COs)	
CO1	Learn the signal processing algorithms and techniques in image enhancement and image restoration.
CO2	Mathematically represent the various types of images and analyze them.
CO3	Process these images for the enhancement of certain properties or for optimized use of the resources.
CO4	Develop algorithms for image compression and coding.
CO5	Get broad exposure to and understanding of various applications of image processing in industry, medicine, and defense.
CO6	Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	3	3	2	2			2		3	3		3	3	3
	CO2	3			2				2			3	1			
	CO3	3	3	3	2								3			
	CO4	3	2	2	3	2			2	3	2	3	2			
	CO5	3		3		2				3	2	2	2			
	CO6	3	3	3	3	2			2	3						
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC061	RF COMMUNICATION CIRCUITS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Analog & Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To learn about the CMOS RF Front End (RFE) building block and in all of wireless and many high frequencies wire-line systems

To learn about the important building blocks within including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, Power Amplifiers, and impedance matching circuits.

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter.

UNIT II IMPEDANCE MATCHING AND AMPLIFIER 9

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations , Compensation, General model – Class A, AB, B, C, D, and F amplifiers, Power amplifier Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

UNIT IV MIXERS AND OSCILLATORS 9

Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, subsampling mixers, Oscillators describing Functions, Colpitts oscillators Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

TEXT BOOK:

1. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge,2004.
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.
3. Jan Crols, Michiel Steyaert, “CMOS Wireless Transceiver Design”, Kluwer Academic. Publishers, 1997.

REFERENCES:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001
2. http://www.ee.iitm.ac.in/~ani/ee6240/
3. https://onlinelibrary.wiley.com/doi/10.1002/9781119259411.ch4

COURSE OUTCOMES (COs)	
CO1	The student after completing this course must be able to translate the top level Wireless architectures
CO2	Communications system specifications into block level specifications of the RFE.
CO3	The student should also able to learn about the feedback concepts
CO4	The students will gain knowledge about the amplifiers
CO5	The present course will introduce the principles of operation and design principles of mixers and oscillators
CO6	The course will also provide and highlight the importance of phased locked system and about frequency synthesizers.

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1						2						1	3	3	3
	CO2	2			3				1	2						
	CO3		2								1					
	CO4			2		1		2								
	CO5	3					3					1				
	CO6				1											
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC062	TELECOM NETWORKS	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Computer Network				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

Understand the concept of a network.

Identify several major developments and trends in the industries, technologies, and business applications of telecommunications and Internet technologies

UNIT I INTRODUCTION TO SWITCHING AND TELECOM NETWORKS 9

Introduction to crossbar & electronics exchange, Types of networks, Network design issues, Design tools, switching technologies (circuit switching and packet switching)

UNIT II BROADBAND TELECOM NETWORKS 9

ISDN, Basic structure, ISDN Interfacing & functions, transmission structure Protocol architecture, Narrow band & Broadband ISDN

UNIT III FRAME RELAY & ATM 9

Frame Relay introduction, Protocol, architecture frame, mode call control, LAPF core Protocol, frame Relay congestion control. ATM, ATM Protocols, Public ATM networks, ATM cells their details and transmission, AAL, Traffic congestion and control.

UNIT IV BROADBAND ACCESS AND ROUTING TECHNOLOGIES 9

DSL, ADSL, Cable modems, WLL, Optical wireless, Leased lines. Routing Algorithms for shortest path centralized routing, Distributed, Static and dynamic routing.

UNIT V TELECOM NETWORK MANAGEMENT 9

Telecom network operation and maintenance, Traffic management, Management of Transport Networks, Configuration management, Fault management, Security, Network planning support, Network management using SNMP: Object management, management Information base, traps.

TEXT BOOK:

1. Aaron Kirshenbaum "Telecommunication Networks Design Algorithms", MGH.
2. Mischa Schwartz, "Telecommunication Networks protocols modelling and analysis" Pearson Education
3. Data and computer communication – William Stallings- PHI.
4. ISDN &Broadband ISDA with Frame Relay & ATM, - William Stallings Pearson Education Asia 4th edition B.E._ETC09.doc - 15 -15
5. Telecommunication Switching, Traffic & networks-J.E.Flood, Pearson Education Asia 1st edition.

REFERENCES:

1. Introduction to Telecommunications: Voice, data& internet- Pearson Education
2. OSS For telecom Networks by Kundan Mishra – Springer.
3. Telecommunication network and management – R.C. Jaiswal
4. Telecom technology by Tyagrajan vishwanathan –PHI
5. ATM Networks by Rainer handel Manfred N. Huber 3rd Edition 2001
6. Computer Networks by Andrew s. tanenbaum.
7. www.telecommunications-tutorials.com

COURSE OUTCOMES (COs)	
CO1	To understand various types of networks and switching technologies
CO2	To gain knowledge about broadband telecom networks
CO3	To understand architecture and protocols of Frame Relay and ATM
CO4	To learn about DSL,ADSL and cable modems
CO5	To gain knowledge about various routing technologies
CO6	To understand Telecom Network Management

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3	2	3	3	2			2	1	2	2		3	3	3
	CO2	2	1	2	2	2			2	1	1	1				
	CO3	2	1	2	1	2			1	2	2	2				
	CO4	2	1	2	2	2			1	1	2	1				
	CO5	3	1	2	2	1			2	1	1	2				
	CO6	3	1	2	2	3			2	1	1	2				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC063	**WIRELESS ADHOC NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours-45	3	0	0	3
	Prerequisite: Computer Networks				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-
To provide more advanced in-depth networking concepts to graduate students. Upon completion of this course, students will be able to apply the knowledge in their networking research

UNIT I AD HOC NETWORKS 6
Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet.

UNIT II MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS 12
Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.

UNIT III ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS 8
Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol.

UNIT IV TRANSPORT LAYER PROTOCOLS FOR AD HOC WIRELESS NETWORK 7
Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks.

UNIT V SECURITY & QUALITY OF SERVICE IN ADHOC WIRELES NETWORKS 12
Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions.

TEXT BOOK:

1. C S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India, 2nd ed. 2005.
2. R. Hekmat, Ad hoc Networks: Fundamental Properties and Network Topologies, Springer, 1st ed. 2006.

REFERENCES:

1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy Efficient Real Time Data Communications, Springer, 1st ed. 2006.
2. Carlos De MoraisCordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
3. G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S.Biagioni, Multi Hop Ad Hoc Networks from Theory to Reality, Nova Science Publishers, 2008
4. https://nptel.ac.in/courses/106105160/

COURSE OUTCOMES (COs)	
CO1	Understand about basics of network.
CO2	Gain knowledge in TCP/IP and ISDN concepts.
CO3	Understand about Internet and Tcp/Ip Networks
CO4	Understand about packet switched networks and circuit switched networks
CO5	Understand about ATM and optical networks
CO6	Understand different networking and switching design

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low																
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	3	3	2	2			2	3	3	3	1	3	3	3
	CO2	2	3	3	2	2			2	3	3	3	3			
	CO3	2	3	3	2	2			2	3	3	3				
	CO4	2	3	3	2	2			2	3	3	3				
	CO5	2	3	3	2	2			2	3	3	3				
	CO6	2	3	3	2	2			2	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC064	EMBEDDED C AND LINUX	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Embedded System				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To expose the students to the fundamentals of embedded Programming.
To Introduce the GNU C Programming Tool Chain in Linux.
To study basic concepts of embedded C, Embedded OS & Python Programming
To introduce time driven architecture, Serial Interface with a case study.
To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.
To learn to implement embedded linux applications

UNIT I EMBEDDED PROGRAMMING 9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

UNIT II C PROGRAMMING TOOL CHAIN IN LINUX 9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities

UNIT III EMBEDDED C 9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT IV EMBEDDED OS 9

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS- Memory requirements - embedding serial communication &scheduling data transmission - Case study: Intruder alarm system.

UNIT V PYTHON PROGRAMMING 9

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

TEXT BOOK:

1. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, "Building embedded linux systems", O'Reilly, 2008.
2. Christopher Hallinan, "Embedded Linux Primer: A practical real world approach", Prentice Hall, 2007.

REFERENCES:

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, Learning Scientific Programming with Python, CAMBRIDGE UNIVERSITYPRESS ,2016.
4. https://www.sciencedirect.com/topics/engineering/high-speed-circuit

COURSE OUTCOMES (COs)	
CO1	Ability to use GNU C to develop embedded software.
CO2	Knowledge and understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware
CO3	To explain programming concepts and embedded programming in C and assembly language
CO4	Understanding and knowledge of python programming, Errors and Exceptions
CO5	Identification of new developments in embedded linux programming
CO6	Analyze the programming languages of real time systems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1		2	3		3			2		3	2	3	3	3	3
	CO2	3			2	3				3	1					
	CO3		2	1		3		2	1		2	1	1			
	CO4	1		2	1	3	2		2		3	2	1			
	CO5	2														
	CO6	2		3		3			3	2		3	2			
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC065	**HIGH SPEED ELECTRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Electronic Devices				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

To learn about the issues involved in high speed electronics
To learn about the materials involved in high speed devices
To understand the working of various high-speed devices

UNIT I INTRODUCTION 9

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high-speed buses; Noise Analysis: radiated emissions and minimizing system noise; Noise Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation, Cross-modulation, Dynamic range

UNIT II MATERIALS FOR HIGH SPEED DEVICES AND CIRCUITS 9

Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs ETC.), silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon-based devices. Brief outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials. Material and device process technique with these III-V and IV – IV semiconductors.

UNIT III AMPLIFIER DESIGN 9

Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages Mixers –Up conversion Down conversion, Conversion gain and spurious response. Oscillators Principles. PLL Transceiver architectures

UNIT IV HIGH SPEED CIRCUITS 9

GaAs Digital Integrated Circuits for high speed operation- Direct Coupled Field Effect Transistor Logic (DCFL), Schottky Diode FET Logic (SDFL), Buffered FET Logic(BFL). GaAs FET Amplifiers. Monolithic Microwave Integrated Circuits (MMICs) High Frequency resonant – tunneling devices. Resonant-tunneling hot electron transistors and circuits.

UNIT V PRINTED CIRCUIT BOARD 9

Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

TEXT BOOK:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press

REFERENCES:

1. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Cambridge University Press, 2004, ISBN 0521835399.
2. Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.
3. Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.

COURSE OUTCOMES (COs)	
CO1	To learn about high frequency power delivery and to analyze the noise involved
CO2	To learn in detail about the various materials involved in High speed devices and circuits
CO3	To understand about the design principles involved in amplifier design
CO4	To understand the working of different high speed devices
CO5	Understand the fabrication procedure for Printed circuit board
CO6	To learn about the various design challenges involved in PCB design

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low																
1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	2	2	2	2	2			2	2	2	2		3	3	3
	CO2	2			2	2			2	2	2					
	CO3	2	3	3	2	2			2	2	2	2				
	CO4	2	3	3	2	2			2	2		2				
	CO5	2	2	2	3	2			3	3	2	3				
	CO6	2	3	3	3	2			3	3	3	3				
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

U18PEEC066	MULTIMEDIA COMPRESSION & COMMUNICATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Computer Networks, Analog and Digital Communication				
	Department:- Dept. of Electronics and Communication Engineering.				

COURSE OBJECTIVES:-

The comprehensive objective of this course is to make students familiar with the different types of compression techniques used for textual, audio, image and video compression

UNIT I MULTIMEDIA COMPONENTS 9

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

UNIT II AUDIO AND VIDEO COMPRESSION 9

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.

UNIT III TEXT AND IMAGE COMPRESSION 9

Compression principles-source encoders and destination encoders-lossless and lossy compression- entropy encoding –source encoding -text compression –static Huffman coding dynamic coding – arithmetic coding –Lempel ziv-welsh Compression-image compression

UNIT IV VOIP TECHNOLOGY 9

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability.

UNIT V MULTIMEDIA NETWORKING 9

Multimedia networking -Applications-streamed stored and audio-making the best Effort service- protocols for real time interactive Applications-distributing multimedia-beyond best effort service- secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

TEXT BOOK:

1.Fred Halshall "Multimedia communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.

REFERENCES:

1. Tay Vaughan, "Multimedia: Making it work", 7 th Edition, TMH 2008 98
2. Kurose and W.Ross "Computer Networking "a Top Down Approach", Pearson Education 2005
3. Marcus Goncalves "Voice over IP Networks", Mc Graw hill 1999.
4. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.
5. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007.
6. https://www.vidyarthiplus.com/vp/Thread-EC6018-Multimedia-Compression-and-Communication-Question-Bank-2017-VEC-Edition#.Xagli5IzbIU

COURSE OUTCOMES (COs)	
CO1	To Apply the compression concepts in multimedia communication.
CO2	To have a complete understanding of error–control coding
CO3	To understand encoding and decoding of digital data streams.
CO4	To introduce methods for the generation of these codes and their decoding techniques
CO5	To have a detailed knowledge of compression and decompression techniques.
CO6	To introduce the concepts of multimedia communication

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
2	CO1	3					2		3	2	3			3	3	3
	CO2	2	1	2				3		1						
	CO3	2	3	2	1		2	1				3				
	CO4	2	3		2	3		2	2		2					
	CO5		1				2			1						
	CO6				2	3	3			2						
3	Category	Professional Elective (PE)														
4	Approval	49th Meetings of Academic Council														

CURRICULUM AND SYLLABUS (R2018)

ACT: Bharath **- F**lexible **A**ccommodative **C**hoice **B**ased **C**redit system for **T**echnology **(Applicable to the batches admitted from July 2018)**

B.Tech – ELECTRICAL AND ELECTRONICS ENGINEERING

(FULL TIME)

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1.	U18HSEN101	HS	Communicative English	3	3	0	0	3
2.	U18BSMA101	BS	Engineering Mathematics - I	4	3	1	0	4
3.	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4.	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5.	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	3	0	0	3
6.	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
PRACTICAL								
7.	*U18BSPH2L2	BS	Wave Optics and Semi-Conductor Physics Lab	2	0	0	2	0
8.	*U18BSCH2L4	BS	Chemistry Lab	2	0	0	2	0
9.	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	3	0	0	3	3
10.	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	4	0	0	4	2
			Total	29	17	1	11	23
ACTIVITY BASED COURSES								
11..	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
12..	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18HSEN201	HS	Technical English	3	3	0	0	3
2.	U18BSMA201	BS	Engineering Mathematics II	4	3	1	0	4
3.	U18BSPH202	BS	Semi-Conductor Physics	3	3	0	0	3
4.	U18BSCH201	MC	Environmental Sciences	3	3	0	0	3

5.	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6.	U18ESME101	ES	Engineering Graphics & Design	3	3	0	0	3
PRACTICAL								
7.	*U18BSPH2L2	BS	Wave Optics and Semi-Conductor Physics Lab	4	0	0	4	2
8.	*U18BSCH2L4	BS	Chemistry Lab	4	0	0	4	2
9.	U18ESCS1L1	ES	Problem Solving and Python Programming Lab	4	0	0	4	2
			Total	31	18	1	12	25
ACTIVITY BASED COURSES								
10.	U18MCAB203	MC	Yoga	2	0	0	2	0
11.	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18BSMA301	BS	Partial Differential Equation and Transformation	4	3	1	0	4
2.	U18PCEE301	PC	Electrical Circuit Analysis	4	3	1	0	4
3.	U18PCEE302	PC	Analog Electronic Circuits	3	3	0	0	3
4.	U18PCEE303	PC	Electrical Machines – I	3	3	0	0	3
5.	U18PCEE304	PC	Electromagnetic Fields	4	3	1	0	4
PRACTICAL								
6.	U18PCEE3L1	PC	Analog Electronic circuits Laboratory	4	0	0	4	2
7.	U18PCEE3L2	PC	Electrical Machines-1 Laboratory	4	0	0	4	2
			Total	26	15	3	8	22
ACTIVITY BASED COURSES								
8.	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
9.	U18MCAB306	MC	Culture – Intangible Cultural, heritage(Festivals, Food ways, Local games)	2	0	0	2	0

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18PCEE401	PC	Digital Electronics	3	3	0	0	3
2.	U18PCEE402	PC	Electrical Machines – II	4	3	1	0	4
3.	U18PCEE403	PC	Power Electronics	3	3	0	0	3
4.	U18PCEE404	PC	Digital Signal Processing	4	3	1	0	4
5.	U18BSMA402	BS	Probability, Statistics & Numerical Methods	4	3	1	0	4
6.	U18HSBA401	HS	Organizational Behavior	3	3	0	0	3
7.	U18MCTH502	MC	Universal Human Values	2	0	0	2	0
PRACTICAL								
8.	U18PCEE4L1	PC	Digital Electronics Laboratory	4	0	0	4	2
9.	U18PCEE4L2	PC	Electrical Machines - II Laboratory	4	0	0	4	2
10.	U18PCEE4L3	PC	Power Electronics Laboratory	4	0	0	4	2

Total				35	18	3	14	27
ACTIVITY BASED COURSES								
11.	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12.	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0

SEMESTER V								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18PCEE501	PC	Power Systems – I (Apparatus and Modelling)	3	3	0	0	3
2.	U18PCEE502	PC	Control Systems	4	3	1	0	4
3.	U18PCEE503	PC	Electrical Machine Design	4	3	1	0	4
4.	U18PCEE504	PC	Measurements and Instrumentation	3	3	0	0	3
5.		OE	Open Elective-1	3	3	0	0	3
6.	U18MCTH401	MC	Constitution of India	2	0	0	2	0
PRACTICAL								
7.	U18PCEE5L1	PC	Power Systems Laboratory - I	4	0	0	4	2
8.	U18PCEE5L2	PC	Control Systems Laboratory	4	0	0	4	2
9.	U18PCEE5L3	PC	Measurements and Instrumentation Laboratory	4	0	0	4	2
			Total	31	15	2	14	23
ACTIVITY BASED COURSES								
10.	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
11.	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0

SEMESTER VI								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18PCEE601	PC	Power Systems – II (Operation and Control)	3	3	0	0	3
2.	U18PCEE602	PC	Microprocessor & Microcontroller	3	3	0	0	3
3.	U18PCEE603	PC	Fuzzy Logic & Neural Networks	3	3	0	0	3

4.		PE	Program Elective - 1	3	3	0	0	3
5.		OE	Open Elective-2	3	3	0	0	3
PRACTICAL								
6.	U18PCEE6L1	PC	Power Systems Laboratory - II	4	0	0	4	2
7.	U18PCEE6L2	PC	Microprocessors & Microcontrollers Laboratory	4	0	0	4	2
8.	U18EEEE 6L3	EE	Technical Seminar	2	0	0	2	1
9.								
			Total	25	15	0	10	20
ACTIVITY BASED COURSES								
11.	U18MCAB611	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12.	U18MCAB612	MC	Self-Development - religion and Inter-faith	2	0	0	2	0

SEMESTER VII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.	U18PCEE701	PC	Smart Grid	3	3	0	0	3
2.		PE	Program Elective - 2	3	3	0	0	3
3.		PE	Program Elective - 3	3	3	0	0	3
4.		PE	Program Elective - 4	3	3	0	0	3
5.		OE	Open Elective-3	3	3	0	0	3
6.	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	0	0	2	0
PRACTICAL								
7.	U18PREE7P1	EE	Project Stage-I	6	0	0	6	3
8.	U18PCEE7L1	PC	Electronics Design Lab	4	0	0	4	2
9.	U18EEEE7L2	EE	Summer Internship	0	0	0	0	1
			Total	27	15	0	12	21
ACTIVITY BASED COURSES								
11.	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
12.	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0

SEMESTER VIII								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1.		MO	Open Elective -4 MOOC	0	0	0	0	2
2.		PE	Program Elective -5	3	3	0	0	3
3.		PE	Program Elective -6	3	3	0	0	3
PRACTICAL								
4.	U18PREE8P1	EE	Project Stage-II	18	0	0	18	9

			Total	24	6	0	18	17
ACTIVITY BASED COURSES								
5.	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0

PROFESSIONAL ELECTIVE –1(Semester VI)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE11	Power system	Power system Protections	3	3	0	0	3
2.	U18PEEE12	Power Electronics & Drives	Line Commutated and Active PWM Rectifiers	3	3	0	0	3
3.	U18PEEE13	Energy Systems &management	Utilization Of Electrical Energy	3	3	0	0	3
4.	U18PEEE14	Controls & Automation	Special Electrical Machines & Controllers	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2(Semester VII)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE21	Power system	HVDC Transmission Systems	3	3	0	0	3
2.	U18PEEE22	Power Electronics & Drives	Solid State DC Drives	3	3	0	0	3
3.	U18PEEE23	Energy Systems &management	Distributed generation and Micro grid.	3	3	0	0	3
4.	U18PEEE24	Controls & Automation	Micro Controller Based System Design	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3(Semester VII)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE31	Power system	High Voltage Engineering	3	3	0	0	3
2.	U18PEEE32	Power Electronics & Drives	Solid State AC Drives	3	3	0	0	3
3.	U18PEEE33	Energy Systems &management	Energy Management Systems and SCADA	3	3	0	0	3

4.	U18PEEE34	Controls & Automation	Bio-Medical Instrumentation	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4(Semester VII)								
Sl.No.	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE41	Power system	Power Quality	3	3	0	0	3
2.	U18PEEE42	Power Electronics & Drives	Solid State Relays	3	3	0	0	3
3.	U18PEEE43	Energy Systems &management	Renewable Energy Sources	3	3	0	0	3
4.	U18PEEE44	Controls & Automation	Industrial Electrical system & Automation	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5(Semester VIII)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE51	Power system	Power System Dynamics and Control	3	3	0	0	3
2.	U18PEEE52	Power Electronics & Drives	Power Converter Analysis and Design	3	3	0	0	3
3.	U18PEEE53	Energy Systems &management	Electric Power Distribution System	3	3	0	0	3
4.	U18PEEE54	Controls & Automation	Instrumentation & Controls in Power Plant Industry	3	3	0	0	3

PROFESSIONAL ELECTIVE – 6(Semester VIII)								
Sl.No	**Code No.**	**Specialization**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18PEEE61	Power System	Flexible AC Transmission Systems	3	3	0	0	3
2.	U18PEEE62	Power Electronics & Drives	Power electronics application to renewable energy system	3	3	0	0	3
3.	U18PEEE63	Energy Systems &management	Wind & Solar Energy Systems	3	3	0	0	3
4.	U18PEEE64	Controls & Automation	Robotics & Automation	3	3	0	0	3

OPEN ELECTIVES FROM EEE

OPEN ELECTIVE								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	U18OEEE01	OE	Green Technologies	3	3	0	0	3
2.	U18OEEE02	OE	Electrical Safety and Quality Assurance	3	3	0	0	3
3.	U18OEEE03	OE	Energy Conservation Techniques	3	3	0	0	3
4.	U18OEEE04	OE	PLC and SCADA for Industrial Automation	3	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL THE B.Tech PROGRAMMES

ALL THE OPEN ELECTIVES COURSES HAVE L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20. U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management

23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33.U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35.U18OEMT004-Artificial Intelligence for Robotics
36.U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43.U18OEEE003-Energy Conservation Techniques
44.U18OEEE004-PLC and SCADA for Industrial
45.U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48.U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55.U18OEEI001-Analytical Methods and Instrumentation
56.U18OEEI002-Introduction to process Data Analytics
57.U18OEEI003-Reliability and Safety in Process industries
58.U18OEEI004-Multi sensor data fusion

59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies

HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1.	U18HSEN101	HS	Communicative English	4	2	0	2	3
2.	U18HSEN201	HS	Technical English	2	1	1	0	2
3.	U18HSBA401	HS	Organizational Behavior	3	3	0	0	3
Total Credits								8

BASIC SCIENCE COURSES (BS)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18BSMA101	Engineering Mathematics - I	4	4	0	0	4
2	U18BSPH101	Waves and Optics	3	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	3	0	0	3
4	U18BSMA201	Engineering Mathematics II	4	4	0	0	4
5	U18BSPH202	Semi Conductor Physics	3	3	0	0	3
6	U18BSCH201	Environmental Sciences	3	3	0	0	3
7	U18BSMA301	Partial Differential Equation and Transformation	4	3	1	0	4
8	U18BSMA402	Probability, Statistics & Numerical Methods	4	3	1	0	4
9	U18BSPH2L2	Wave Optics and Semi Conductor Physics Lab	3	0	0	3	2
10	U18BSCH2L4	Chemistry Lab	3	0	0	3	2
Total Credits							28

ENGINEERING SCIENCE COURSES (ES)

Sl.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1.	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
2.	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3.	U18ESCS101	ES	Programming for Problem Solving	3	3	0	0	3
PRACTICAL								
4.	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
5.	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	2
Total Credits								14

PROFESSIONAL CORE COURSES

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1.	U18PCEE301	PC	Electrical Circuit Analysis	4	3	1	0	4
2.	U18PCEE302	PC	Analog Electronic Circuits	3	3	0	0	3
3.	U18PCEE303	PC	Electrical Machines – I	3	3	0	0	3
4.	U18PCEE304	PC	Electromagnetic Fields	4	3	1	0	4
5.	U18PCEE401	PC	Digital Electronics	3	3	0	0	3
6.	U18PCEE402	PC	Electrical Machines – II	4	3	1	0	4
7.	U18PCEE403	PC	Power Electronics	3	3	0	0	3
8.	U18PCEE404	PC	Digital Signal Processing	4	3	1	0	4
9.	U18PCEE501	PC	Power Systems – I (Apparatus and Modelling)	3	3	0	0	3
10.	U18PCEE502	PC	Control Systems	4	3	1	0	4
11.	U18PCEE503	PC	Electrical Machine Design	4	3	1	0	4
12.	U18PCEE504	PC	Measurements and Instrumentation	3	3	0	0	3

13.	U18PCEE601	PC	Power Systems – II (Operation and Control)	3	3	0	0	3
14.	U18PCEE602	PC	Microprocessor & Microcontroller	3	3	0	0	3
15.	U18PCEE603	PC	Fuzzy Logic & Neural Networks	3	3	0	0	3
16.	U18PCEE701	PC	Smart Grid	3	3	0	0	3
PRACTICALS								
17.	U18PCEE3L1	PC	Analog Electronic circuits Laboratory	3	0	0	3	2
18.	U18PCEE3L2	PC	Electrical Machines-1 Laboratory	3	0	0	3	2
19.	U18PCEE4L1	PC	Digital Electronics Laboratory	3	0	0	3	2
20.	U18PCEE4L2	PC	Electrical Machines - II Laboratory	3	0	0	3	2
21.	U18PCEE4L3	PC	Power Electronics Laboratory	3	0	0	3	2
22.	U18PCEE5L1	PC	Power Systems Laboratory - I	3	0	0	3	2
23.	U18PCEE5L2	PC	Control Systems Laboratory	3	0	0	3	2
24.	U18PCEE5L3	PC	Measurements and Instrumentation Laboratory	3	0	0	3	2
25.	U18PCEE6L1	PC	Power Systems Laboratory - II	3	0	0	3	2
26.	U18PCEE6L2	PC	Microprocessors &Microcontrollers Laboratory	3	0	0	3	2
27.	U18PCEE7L1	PC	Electronics Design Lab	4	0	0	4	2
Total Credits								

EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18EEEE 6L3	Technical Seminar	2	0	0	2	1
2	U18EEEE6L4	Internship					1
3	U18PREE7P1	Project Stage-I	6	0	0	6	3
4	U18PREE8P2	Project Stage-II	18	0	0	18	9
Total Credits							14

MANDATORY COURSES (MC)

Sl.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1.	U18MCTH401	MC	Constitution of India	2	2	0	0	0
2.	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
3.	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
4.	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
5.	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
6.	U18MCAB203	MC	Yoga	2	0	0	2	0
7.	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
8.	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
9.	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
10.	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11.	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
12.	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
13.	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
14.	U18MCAB611	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
15.	U18MCAB612	MC	Self-Development -	2	0	0	2	0

			religion and Inter-faith					
16.	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
17.	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
18.	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total Contact Hours	36				

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S. No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management courses (HS)	3	3		3					9	5.14
2	Maths & Basic Sciences (BS)	12	11	4	4					31	17.71
3	Engineering Sciences (ES)	8	8							16	9.14
4	Professional Core (PC)			18	20	20	13	5		76	43.42
5	Professional Electives (PE)						3	9	6	18	10.28
6	Open Electives (OE)					3	3	3		9	5.14
7	Massive Open Online Course(MOOC)								2	2	1.14
8	Employment Enhancement Courses (EE)						1	4	9	14	8.00
9	Mandatory courses(MC)									0	
	Total Credit	23	22	22	27	23	20	21	17	175	100.00
	Total Contact Hour	29	31	26	35	31	25	27	24		

SEMESTER – 1

U18HSEN101	Communicative English	L	T	P	C
	Total Contact Hours – 45	2	0	2	3
	Prerequisite course –NIL				
	Course Coordinator: Ms.A.S.Ragvi. Department:-English				

COURSE OBJECTIVES:- To emphasis and develop language skills to satisfy the needs of work environment. To inculcate reading and listening habits and thereby improvising speaking and writing skills.

COURSE OUTCOMES (COs)

CO1	R	Recall and list language skills for business related situations.
CO2	U	Understand and intensely focus on improving and increasing LSRW Skills
CO3	A	Apply a good command over basic writing technical report and reading skills.
CO4	An	Infer and use vocabulary in corporate work environment.
CO5	E	Examine Task- Based activity to enhance an effective communication
CO6	C	Actualize communication skills for employability

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1
2	CO1	3			2			3		2				
	CO2	1			1			3		2				--
	CO3	1			2			3		2				
	CO4	1			1			3		3				
	CO5	1			2			3		2				
	CO6	1			1			3		3				

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/
			BS							
4	Approval									

UNIT I SPEAKING **6 hours**

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations:Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing one self – exchanging personal information- narrating events, -incidents , speakingabout one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts ofspeech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6 hours

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short readingtexts-- and longer passages - understanding text structure- use of reference words and discoursemarkers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -The concept of Word Formation.

UNIT III LISTENING 6hours

Listening – listening to longer texts and filling in the table- product description- asking aboutroutine actions and expressing opinions. –Listening to telephonic conversations -degrees ofcomparison- pronouns- direct vs indirect questions- Vocabulary development – single wordsubstitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement.

UNIT IV WRITING 6 hours

Writing- letter writing, formal and personal letters- after listening to dialogues or conversationsand completing exercises based on them. Understanding text structure- use of reference words anddiscourse markers-coherence-jumbled sentences -Tenses- simple present- simple past- presentcontinuous and past continuous- Vocabulary development- synonyms- antonyms- phrasal verbs-Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6hours

Writing short essays – developing an outline- identifying main and subordinate ideas- dialoguewriting- listening to talks, conversations to complete the remaining, participating inconversations- short group conversations-Language development-modal verbs- present/ pastperfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions .Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Useof phrases and clauses in sentences - Importance of proper punctuation - Creating coherence-Organizing principles of paragraphs in documents- Techniques for writing precisely.

TEXT BOOKS

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan
Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges.Cengage
Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

CourseCoordinator HOD

SOFTSKILL LABORATORY

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews &conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds- intonation.
12. Creative and critical thinking.

U18BSMA101	**Engineering Mathematics – I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course –Nil				
	Course Coordinator: Mr. VivekKumaran. Department:-Mathematics				

COURSE OBJECTIVES:-The aim is to develop mathematical curiosity and use inductive and deductive reasoning when solving problems, and to develop the knowledge,skills and attitudes necessary to pursue further studies in Mathematics and tobecome confident in using Mathematics to analyze and solve problems in real – life situations.

COURSE OUTCOMES (COs)

CO1	R	To remember both the limit definition and rules of differentiatefunctions.
CO2	U	Understand the Theorem ant its application of analysis to Engineering problems. Also they will have a basic understanding of Beta and Gamafunctions.
CO3	A	To apply differential and integral calculus to notions of curvature. Also applydifferentiation to find maxima and minima of functions. To apply definite integrals of algebraic and trigonometric functions using formulas and substitution.
CO4	An	To analyze multiple integrals to compute area and volume over curves, surface anddomain in two dimensional and three dimensional spaces.
CO5	E	To examine Eigenvalue problems from practical areas using transformations;Diagonalising the matrix that would render the Eigen values.
CO6	C	To design differentiation and integration techniques to solve engineering problems

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1
2	CO1	3				2		1			1			
	CO1	3			1					3				
	CO2	3			1					2				
	CO3	3			1					2				
	CO4	3			1					2				
	CO5 CO6	3 3			1 1					3 3				

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

UNIT I THEORY OF EQUATIONS (9+3) hours

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs
theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation
of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variabl (9+3) hours

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule
– Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem –
Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3) hours

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total
derivative – Jacobian–Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variables (9+3)hours

Definite integrals – Substitution rule – Techniques of integration – Integration by parts –
Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by
partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3)hours

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–-Cayley-
Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical
form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10 th edition, John Wiley & Sons, Singapore,
2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9 th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,
Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., ManickavachagamPillai T.K., Ramanaiah G., Advanced Mathematics for
Engineering students, Volume I (2 nd edition), S.Viswanathan Printers and Publishers, 1992.

CourseCoordinator HOD

U18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course -Nil				
	Course Coordinator: Ms.Radhika. Department:-Physics				

COURSE OBJECTIVES:-To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

COURSE OUTCOMES (COs)

CO1	R	Recall the basic concept of waves and lights
CO2	U	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	A	Apply the propagation of light and geometrical optics
CO4	An	Analyze the optical phenomenon like interference, diffraction and superposition of waves
CO5	E	Evaluate the operation of laser and its applications
CO6	C	Design applications of lasers in science, engineering and medicine.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	PS O2
2	CO1	3			3					3					
	CO2	1			2					3					
	CO3	3								2					
	CO4	3								2					
	CO5	3			2					3					
	CO6	3			2					3					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE

DIMENSION **9 hours**

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves,reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the

wave equation for them, acoustics waves and speed of sound. Waves with dispersion,superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES **9 hours**

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating–Detection - Non Destructive Testing – pulse echo system through transmission and reflection

modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9 hours

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of

reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and

transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses

and optical instruments based on them.

UNIT 4 WAVES OPTICS **9 hours**

Huygens' principle, superposition of waves and interference of light by wavefront splitting and

amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer.

Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their

resolving power.

UNIT 5 LASERS **9 hours**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light

by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-statelasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and

brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1. M.N. Avadhanulu and P.G. Kshirsagar, “A Textbook of Engineering Physics” S.Chand Publishers, 2016 (for Units 1,3,4& 5)
2. G.Senthil Kumar, “Engineering Physics”, VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1. BrijLal and Subramanian, “Waves and Oscillation”, VikasPublishsing House, 2011
2. R.Murugesan,“Optics and Spectroscopy”, S.Chand Publishers, 2015
3. BrijLal and Subramanian,“Optics”, S.Chand Publishers 2006
4. Ian G. Main, “Vibration and waves in physics”, Cambridge University Press, 1978
5. H.J. Pain, “The physics of vibrations and waves”, 6th edition, Wiley 2006
6. AjoyGhatak, “Optics”, Tata McGraw-Hill publishing company, New Delhi, 2009
7. O. Svelto, “Principles of Lasers”, Springer, 2010
8. Online reference Wikipedia.org.

CourseCoordinator HOD

U18BSCH101	**Engineering Chemistry**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –Nil					
	Course Coordinator: Dr.P.Mahesn. Department:-Chemistry					

COURSE OBJECTIVES:-To gain fundamental knowledge of Engineering Chemistry and its applications

COURSE OUTCOMES (COs)

CO1	R	To remember the principles of Conventional and non-conventional energy sources and energy storage devices
CO2	U	To understandthe principles, water characterization,conversant with boiler feed water requirements and water treatment techniques.
CO3	A	. To apply industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO4	An	To analyze the Chemistry of Fuels and calorificvalue, manufacture of solid, liquid and gaseous fuels.
CO5	E	To evaluate the Nanochemistry, Types of nanomaterials:Nanoparticles,Nanochemistry in biology and medicines.
CO6	C	To design industrial application using conventional and non-conventional energy sources and energy storage devices

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 3	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3			1					3					
	CO2	3			1					2					
	CO3	3			1					2					
	CO4	3			1					3					
	CO5	3			1					3					
	CO6	3			1					3					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

UNIT I WATER TECHNOLOGY 9hours

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness -Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and MethylOrange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods(Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantagesof using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) –Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatmentmethod) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9 hours

Introduction: Statement of Phase Rule and Explanation of terms involved – One componentsystem – Water system – Construction of phase diagram by thermal analysis - Condensed phaserule - Two Component System : Simple eutectic systems (lead-silver system) – eutectictemperature – eutectic composition – Pattinson's Process of desilverisation of Lead.Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel – heattreatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding.Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9hours

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass – super critical mass - sub - critical mass Light water nuclear reactor for Power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9hours

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas,CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9hours

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes – Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis.Nano composites – sensors and electronic devices.

TEXT BOOKS

1. P.C.Jain and Monica Jain, “Engineering Chemistry” DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara “A text book of Engineering Chemistry” S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES BOOKS

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

CourseCoordinator HOD

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –Nil					
	Course Coordinator:Ms.Venkateswari. Department:-EEE					

COURSE OBJECTIVES:-To gain fundamental knowledge of Electrical and Electronics Engineering and its applications

COURSE OUTCOMES (COs)

CO1	R	To remember laws and theorems associated with DC ,AC circuits and machines.
CO2	U	To understand the principle of operation od AC & AC Machines & Transformers and semiconductors Devices & Digital systems
CO3	A	To apply knowledge to electrical machines, transformers and semiconductors Devices & Digital systems
CO4	An	To analyse various types electrical circuits , semiconductor devices and small signal amplifiers.
CO5	E	To evaluate AC ,DC machines and transformers applied to distribution networks
CO6	C	To design applications of semiconductors Devices & Digital systems

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 2	PSO
2	CO1	3	3			2				3				2	
	CO2	3	1			2				3				2	
	CO3	3	2			2				3				2	
	CO4	3	1			2				3				2	
	CO5	3	1			2				3				2	
	CO6	3	3			2				3				2	

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
				ES						
4	Approval									

UNIT 1 DC CIRCUITS 9 hours

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI forRLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis ofsimple circuits with dc excitation. Basics of Superposition, Thevenin and NortonTheorems,Maximum Power Transfer Theorem.

UNIT 2 AC CIRCUITS 9 hours

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power,reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting ofR, L, C, RL, RC, RLC combinations (series and parallel), resonance.Time-domain analysis offirst-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations instar and delta connections.

UNIT 3 ELECTRICAL MACHINES & TRANSFORMERS 9 hours

Principles of operation and characteristics of; DC machines,Synchronous machines, three phaseand single phase induction motors. Transformers (single and three phase) regulation andefficiency,all day efficiency and auto-transformer .

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS 9 hours

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Halfwave and Full wave Rectifiers – Voltage Regulation.Bipolar Junction Transistor – CB, CE, CCConfigurations and Characteristics – Elementary Treatment of Small Signal Amplifier and itsapplications, Introduction to OP-AMP.

UNIT 5 DIGITAL ELECTRONICS 6hours

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops –Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS

1. John Bird,,Electrical Circuit Theory & Technology,Taylor& Francis Ltd, 6 th , edition. 2017.
2. SmarajitGhosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI
Learning, 2007.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2011.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson, 2nd Edition, 2015.
6. Millman and Halkias, “Integrated Electronics”, McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Higher Ed, 1st Edition, 2011.
3.JacobMillman and Christos C-Halkias,"Electronic Devices and Circuits", McGraw Higher Ed,
4th Edition, 2015.

CourseCoordinator HOD

U18BSBT101	BIOLOGY FOR ENGINEERS	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite course –Nil				
	Course Coordinator: Ms.Poorni. Department:-Industrial Biotechnology				

COURSE OBJECTIVES:-To provide a basic understanding of the biological systems and its applications inthe industrial sector

COURSE OUTCOMES (COs)

CO1	U	To remember the basic concepts of the cell and its structure
CO2	U	To understand about biodiversity and its conservation
CO3	Ap	Applyfundamentals of genetics and the immune system
CO4	An	To analyze the applications of bio systems in environment, medical and agricultural sectors
CO5	E	To eveloateapplications of transgenics
CO6	C	To create an awareness about human diseases

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	1		1		2			1					
	CO2	3	1		2		3			2					
	CO3	2			1		2			1					
	CO4	3			1		1			1					
	CO5	3	3		1		1			2					
	CO6	3			1		1			1					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

UNIT I INTRODUCTION TO LIFE 6hours

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic andeukaryotic cell- Introduction to biomolecules - general classification and important functions ofcarbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6hours

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System:elementary study of digestive-respiratory-circulatory-excretory systems and their functions.Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6hours

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity-antigens-antibody-immuneresponse.

UNIT IV HUMAN DISEASES 6hours

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer,hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6hours

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-iochips.

TEXT BOOKS

1. A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company,
2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

CourseCoordinator HOD

U18BSPH2L2	**Wave optics and semiconductor Physics Laboratory**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	0	0	3		1.5
	Prerequisite course –Nil					
	Course Coordinator:Ms.Radhika. Department:-Physics					

COURSE OBJECTIVES:-To impart knowledge of Semiconductor practical Physics

COURSE OUTCOMES (COs)

CO1	R	To remember the fundamental concept of optics& waves
CO2	U	To Understand the concept of production of ultrasonic waves and optics
CO3	A	To relate to the functions of semiconductor and optic applications
CO4	An	To analyze the operations of semiconductor and optic applications
CO5	E	To evaluate optics& waves usages

CO6	C	To designsemiconductor and optic applications													
	Mapping of Course Outcomes with Program outcomes (Pos) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	Cos/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3	2	3						1	3	2	2		
	CO2	3	3	1						1	3	2	2		
	CO3	2	3	3						1	3				
	CO4	3	2	2						2	3				
	CO5	3	2	2						2	3	2	2		
	CO6	3	2	2						2	2	1	1		
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other		Project/Term Paper/ Seminar/ Internship(PR)	
				BS											
4	Approval														

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Semiconductor Physics – Circuit branches

1) Determination of Band Gap
2) Zener diode characteristics
3) p-n junction diode Characteristics
3) Transistor Characteristics
5) V-I characteristics using LDR circuit
6) Carey Foster's Bridge

CourseCoordinator HOD

U18BSCH2L4	Chemistry Laboratory	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite course –Engineering Chemistry				
	Course Coordinator:Ms.Mdhubala. Department:-Chemistry				

COURSE OBJECTIVES:-To enhance the practical knowledge on Chemistry through Volumetric andcircuit experiments.

COURSE OUTCOMES (Cos)

CO1	R	Remember the concept of spectrophotometric method and water treatment
CO2	U	Understand basic principle of spectrophotometric method and water treatment
CO3	A	Students will learn Conductometric Titration of Strong Acid with Strong Base and andConductometric Precipitation titration.
CO4	An	Students will able to analyze – hardness, Alkalinity, Dissolved oxygen and to analyze Determination of Molecular weight of a polymer by Viscosity Average Method.
CO5	E	Predict pH measurements for Acid – alkali Titrations and rate of corrosion by weight loss method
CO6	C	Design applications for environment domain

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	2	2	2		3		3		1				
	CO2	1	3			2		3		2		1			
	CO3		1		2						2				
	CO4	3		2				2				3			
	CO5	3	3		1		2				3				
	CO6	3	3							3	2	2			

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by
EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)

5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

CourseCoordinator HOD

U18ESME1L2	**Workshop/Manufacturing Practices**	**L**	**T**	**P**		**C**
	Total Contact Hours – 75	1	0	4		3
	Prerequisite course –NIL					
	Course Coordinator:Mr.Saravana Kumar. Department:-Mechanical Engineering					

COURSE OBJECTIVES:-To educate the students on common manufacturing processes employed in Industries.

COURSE OUTCOMES (COs)

CO1	R	Students will gain knowledge of the different manufacturing processes.
CO2	U	Students will be able to fabricate components with their own hands.
CO3	A	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	An	To analyse the dimensional accuraciesand dimensional tolerances.
CO5	E	To evaluate different manufacturing processes.
CO6	C	Students will be able to produce small devices of their interest

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	2							2		3			
	CO2	3	2	3	2					2		3			
	CO3	3	2							2					
	CO4	3	2		1					2		3			
	CO5	3	3							2					
	CO6	3	3							2					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
				ES						
4	Approval									

SYLLABUS

Lectures & videos **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lecture)
- CNC machining, Additive manufacturing (2 lecture)
- Fitting operations &power tools (2 lecture)
- Carpentry (2 lecture)
- Plastic moulding, glass cutting (2 lecture)
- Metal casting (2 lecture)
- Welding (arc welding & gas welding), brazing (2 lecture)

WORKSHOP PRACTICE

1. Machine shop (6 hours)
   a) Facing
   b) Turning
   c) Drilling Practice
2. Fitting shop (6 hours)
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.
3. Carpentry (9 hours)
   a) Preparation Lap joints.
   b) Mortise and Tenonjoints.
   c) Cross Half.
   d) Dove Tail.
4. Welding shop (Arc welding 6 hrs + gas welding 3 hrs) (9 hours)
   Preparation of butt joints, lap joints and tee joints
5. Sheet Metal working (9 hours)
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints
6. Demonstration (6 Hours)
   Smithy operations, upsetting, swaging, setting down and bending.
   Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or moreof the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th
edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4 th edition, Prentice Hall India,
1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

CourseCoordinator HOD

U18ESEE1L3	**Basic Electrical And Electronic Engineering Practices laboratory**	**L**	**T**	**P**		**C**
	Total Contact Hours – 30	0	0	3		1.5
	Prerequisite course -Nil					
	Course Coordinator: Ms.Sathyapriya. Department:-EEE					

COURSE OBJECTIVES:-To enhance the practical knowledge on basics of electrical and electronics Components and circuits.

COURSE OUTCOMES (COs)

CO1	R	To handle basic electrical equipment and verify current and voltage law
CO2	U	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	A	To produce domestic wiring procedures practically.
CO4	An	To analyze ac signal parameters using cathode ray oscilloscope andfunction generator
CO5	E	To discriminate l concepts semiconductor Diodeand Transistor
CO6	C	To design logic Gates and Flip-Flaps and applications of operational amplifier

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3	3			3				3		2			
	CO2	3	3			3				3		2			
	CO3	3	3			3				3		2			
	CO4	3	3			3				3		2			
	CO5	3	3			3				3		2			
	CO6	3	3			3				3		2			

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
				ES						
4	Approval									

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchhoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to
step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary
and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement),
induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring
arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier.

CourseCoordinator HOD

SEMESTER – II

U18HSEN201	**Technical English**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	1	1	0		2
	Prerequisite course –Nil					
	Course Coordinator:Mr.Gopinath. Department:-English					

	COURSE OBJECTIVES:-To gain fundamental knowledge of English language and its usage in day to day life.
	COURSE OUTCOMES (COs) On completion of the course, the students will be able to

CO1	R	Recall language skills for business related situations.
CO2	U	Understand and intensely focus on improving and increasing LSRW Skills
CO3	A	Relate a good command over basic writing technical report and reading skills.
CO4	An	Analyze and use vocabulary in corporate work environment.
CO5	E	Evaluate Task- Based activity to enhance an effective communication
CO6	C	Plan communication skills for employability

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3			2			3		2					
	CO2	1			1			3		2					
	CO3	1			2			3		2					
	CO4	1			1			3		3					
	CO5	1			2			3		2					
	CO6	1			1			3		3					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
		HS								
4	Approval									

UNIT I LISTENIN 6 hours

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions – listening todaily issue- -Vocabulary Development- technical vocabulary - Language Development –subjectverb agreement – compound words.

UNIT II READING 6 hours

Reading – reading longer technical texts- identifying the various transitions in a text- interpretingcharts, graphs after reading the, practice in speed reading- vocabulary Development-vocabularyused in formal letters/emails and reports -Language Development personal passive voice,numerical adjectives.

UNIT III TECHNICAL WRITING 6 hours

Writing after listening to classroom lectures- talk should be on engineering /technology–introduction to technical presentations- longer texts both general and technical, Describing aprocess, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 6 hours

Writing- email etiquette- job application – cover letter –Resume preparation (via email

and hardcopy)- analytical essays and issue based essays–Vocabulary Development- finding suitablesynonyms-paraphrasing-. Language Development- clauses- dependent, independent, ifconditionals.

UNIT V LANGUAGE DEVELOPMENT 6 hours

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of ameeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, LanguageDevelopment- reported speech.

TEXT BOOKS

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges CengageLearning, USA: 2007.

CourseCoordinator HOD

U18BSMA201	**Engineering Mathematics – II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course –Engineering Mathematics 1				
	Course Coordinator:Ms.Pavi. Department:-Mathematics				

COURSE OBJECTIVES:-The objective of this course is to equip the students of Engineering andTechnology with techniques in ordinary equations, vector calculus, complexvariables and Laplace transform with advanced level of mathematics andapplications that would be essential to formulate problems in engineeringenvironment..

COURSE OUTCOMES (COs) On completion of the course, the students will be able to

CO1	R	.To remember the concept of differential equation, vector calculus and analytical functions
CO2	U	To understand the analytic functions, conformal mapping and complex integration andtheir applications.
CO3	A	To relatemathematical tools for solution of differential equation that model physicalprocess
CO4	An	To study the line, surface and volume integrals using Green's, Stoke's and GaussTheorems and their verification.
CO5	E	. To evaluate real and complex integrals using the Cauchy's integral formula and Residuetheorem.
CO6	C	To design an application of Laplace Transformation in analysis and solve differentialequations

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2				3				2		3			
	CO2	3				3				2		1			
	CO3	3				2				3		1			
	CO4	3				2				2		1			

	CO5	3				2				2		3			
	CO6	3				2				2		1			
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)			Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)		
				BS											
4	Approval														

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3) hours

Higher order linear differential equations with constant coefficients – linear differential equationswith variable coefficients– Euler's and Legendre's linear equations – Simultaneous first orderlinear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3) hours

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Anglebetween two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem– Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes andrectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)hours

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (withoutproof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomsonmethod –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3) hours

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3) hours

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms ofderivatives and integrals – Initial and final value theorem – Laplace transform of PeriodicFunctions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to secondorder with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9 th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35 th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition,Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12 th Edition,Addison-Wesley, Pearson.

CourseCoordinator HOD

U18BSPH202	Semiconductor Physics	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Nil				
	Course Coordinator:Mr.Seevagan. Department:-Physics				

COURSE OBJECTIVES:-To develop physics and engineering strategies of semiconductor materials and to discusstheir functionalities in modern electronic and optoelectronic devices

COURSE OUTCOMES (COs)

CO1	R	To define Electronic States Of Semiconductors and concepts
CO2	U	Understand the importance of doping to charge carrier density and difference between metals, semiconductors and insulators
CO3	A	To demonstrate the electrical transport in semiconductors
CO4	An	To discriminate the difference between direct and indirect semiconductors
CO5	E	Justification of electrical and optical transport techniques
CO6	C	Designing of semiconductor devices

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3				2				1					
	CO2	3				2				1					
	CO3	3				2				2					
	CO4	3				2				1					
	CO5	3				2				1					
	CO6	3				2				2					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							

4	Approval		

UNIT1 INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS
9 hours

Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone andrules for band (k - space) representation. Dynamics of electrons in periodic potential:Kronig - penny and nearly free electron models - Real methods for band structure calculations; Band gapsin semiconductors - Holes and effective mass concept - Properties of conduction and valancebands.

UNIT2 CARRIERS AND DOPING 9 hours

Fermi distribution and energy - Density of states - Valance and conduction band density of states- intrinsic carrier concentration – intrinsic Fermi level. Extrinsic semiconductors: n and p typedoping - Densities of carriers in extrinsic semiconductors and their temperature dependence -

extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Band gap engineering

UNIT 3 ELECTRICAL TRANSPORT 9 hours

Scattering Mechanism: electron - electron and electron – phonon scattering. Macroscopictransport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field andvery high field.

UNIT 4 OPTICAL TRANSPORT 9 hours

Electron - hole pair generation and recombination: band to band (direct and indirect band gaptransitions) and intra band (impurity related) transitions, free - carrier & phonon transitions.Excitons: Origin, electronic levels and properties. Carrier transport - continuity equations.Optical constants: Kramers - Kronig relations.

UNIT 5 SEMICONDUCTOR AS DEVICES AND RECENT ADVANCES 9 hours

Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductorjunctions - processes).

TEXT BOOK

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.ChandPublishers, 2014(for units 1 and 2)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 5)

REFERENCES BOOKS

1) Kevin F Brennan, "The Physics of Semiconductors", Cambridge Univ.Press 1999.
2) Peter Y Yu and Manuel Cardona, "Fundamentals of Semiconductors",Spriger, 1996.

CourseCoordinator HOD

U18BSCH201	**Environmental Science**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –NIL					
	Course Coordinator:Dr.Chandrabose. Department:-Chemistry					

COURSE OBJECTIVES:-

- To study the interrelationship between living organism and environment.
- To study of the nature and concepts of ecosystem.
- To learn about the integrated themes and biodiversity of an environment.
- To study of pollution control and waste management.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functionsand its value.

COURSE OUTCOMES (COs)

CO1	R	To recognize core concepts and methods from ecological and physical sciences. and theirapplication inenvironmental problem solving
CO2	U	Understand the transnational character of environmental problems and ways ofaddressing them, including interactions across local to global scales
CO3	A	To form methods from ecological and physical sciences and theirapplication in environmental problem solving.

CO4	An	Analyze the impact of engineering solutions in a global and societal context.
CO5	E	Evaluate and understand interactionsbetween social and environmental processes
CO6	C	Plan the gained knowledge to overcome pollution problems

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	2		3			3		3	2					
	CO2	3		3			2		3	2					
	CO3	3		2			1		3	3					
	CO4	2		2			2		3	2					
	CO5	2		3			2		3	2					
	CO6	2		3			2		3	2					

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							
4	Approval									

UNIT I NATURAL RESOURCES 9hours

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soilerosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II ECOSYSTEMS 9hours

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers,consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains,food webs and ecological pyramids - Introduction, types, characteristic features, structure andfunction of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem,Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rainwater harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues andPossible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III BIODIVERSITY AND ITS CONSERVATION 9hours

Introduction and Definition - genetic, species and ecosystems diversity, biogeographicallyclassification of India - Value biodiversity: consumptive use, productive use, social, ethical,aesthetic and option values - Biodiversity at global, national and local levels. India as a megadiversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife,man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL SOLLUTION 9hours

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution,Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management:Causes, effects and control measures of urban and industrial wastes - Role of an individual inprevention of pollution - pollution case studies - Disaster Management: floods earthquake,cyclone and landslides.

UNIT V SOCIAL ISSUES AND HUMAN SOPULATION 9hours

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water(Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act,Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks– (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) –Harmful nature of ingredients – chemical effects on health due to inhaling fumes.Human population: population growth, variation among nations, Population explosion-FamilyWelfare programs, Environment and human health, Human Rights, Value Education, HIV andAIDS, Women and Child Welfare, Role of Information Technology in Environment and Humanhealth - Case Studies.

TEXT BOOKS

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol.I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”

REFERENCES

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

CourseCoordinator HOD

U18ESCS101	**Problem Solving And PythonProgramming**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –NIL					
	Course Coordinator:Mr.Sivaraman.R. Department:-Computer Science Engineering					

COURSE OBJECTIVES:-

To gain fundamental knowledge of algorithmic problem solving and pythonprogramming

COURSE OUTCOMES (COs)

CO1	U	Recall algorithmic components to simple computational problems
CO2	R	Demonstrate programs using simple Python statements and expressions.
CO3	A	To gain knowledge regarding control flow and functions associated with python

CO4	An	Use Python data structures, dictionaries for representing compound data
CO5	E	To discriminate knowledge on files, exception, modules and packages in Python for solvingproblems
CO6	C	To design simple application programs

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3	3	3	2	3	2	1		2	1	2			
	CO2	3	3	2	2		2		1			2			
	CO3	2	2	1	3	2		1		1		2			
	CO4	2	2	1	2	3	2	1	2	1		2			
	CO5	2	3	1	2	2			2	2	1				
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
				ES						
4	Approval									

UNIT I ALGORITHIMIC PROBLEM SOLVING 9 hours

Introduction to components of a computer system - disks, memory, processor, operating system,compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Buildingblocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flowchart,programming language), algorithmic problem solving, simple strategies for developingalgorithms (iteration, recursion). Problem Illustrations

UNIT II DATA, EXPRESSIONS, STATEMENTS 9 hours

Python interpreter and interactive mode; values and types: int, float, boolean, string, andlist;variables, expressions, statements, tuple assignment, precedence of operators, comments;modulesand functions, function definition and use, flow of execution, parameters and arguments;Illustrativeprograms: exchange the values of two variables, circulate the values of n variables,distance betweentwo Points.

UNIT III CONTROL FLOW, FUNCTIONS 9 hours

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chainedconditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions:return values, parameters, local and global scope, function composition, recursion; Strings:stringslices, immutability, string functions and methods, string module; Lists as arrays. Illustrativeprograms: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNITIV LISTS, TUPLES, DICTIONARIES 9 hours

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists,listparameters;Tuples: tuple assignment, tuple as return value; Dictionaries: operationsandmethods;advancedlist,Processing list comprehension; Illustrative programs: selection sort,insertion sort, mergesort, histogram.

UNIT V FILES, PACKAGES **9hours**

Files and exception: text files, reading and writing files, errors and exceptions, handlingexceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS

1.

Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

2.Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updatedf

or Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revisedand expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning,2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A ComputationalProblem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers,LLC, 2013.

CourseCoordinator HOD

U18ESME101	**Engineering Graphics Design**	**L**	**T**	**P**		**C**
	Total Contact Hours – 75	1	0	4		3
	Prerequisite course –Mathematics 1					
	Course Coordinator:Mr.T.Manikandan. Department:-Mechanical Engineering					

COURSE OBJECTIVES:-

To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES (COs)

CO1	R	Recall the principle of Engineering Graphics
CO2	U	Explain the standards of engineering graphics.
CO3	A	Exposure to basics of building construction
CO4	An	Differentiate computer-aided geometric design
CO5	E	Predict visual aspects of EngineeringDesign.
CO6	C	Design and producing drawings by using CAD.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3			2			3							

	CO2	3	3	1		3	2								
	CO3			3											
	CO4											3			
	CO5	3						1							
	CO6														
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)		Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)		
					ES										
4	Approval														

UNIT I TRADITIONAL ENGINEERING GRAPHICS

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; DrawingPrinciples; Isometric Projection; Surface Development; Perspective; Reading a Drawing;Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, ShortestDistance.

UNIT II COMPUTER GRAPHICS

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; ModelViewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing;Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to BuildingInformation Modelling (BIM)(Except the basic essential concepts, most of the teaching part can happen concurrently inthe laboratory)

UNITIII INTRODUCTION TO ENGINEERING DRAWING (9+2Hrs)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

UNIT IV ORTHOGRAPHIC PROJECTIONS (10+2 Hrs)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographicprojection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane –Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections ofplanes inclined to either HP or VP;

UNIT V PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS(10+3Hrs)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane;Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions – Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

UNIT VI SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFAC(10+3Hrs)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

UNIT VII BUILDING DRAWING (9+2Hrs)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales forvarious types of Drawings,Symbols, Conventions and Abbreviations.Drawing of residential singleand two storied buildingswith detail of Line plan, Foundation Plan, Ground floor Plan, First floorplan, Elevation and Sections.

UNIT VIII OVERVIEW OF COMPUTER GRAPHICS (12+3 Hrs)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawinglimits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographicconstraints, Snap to objects manually and automatically; Setup a drawing with proper scale–Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings byusing various coordinate input entry methods to draw straight lines, Applying various ways ofdrawing circles;Create basic drawing of objects such as polygon and general multi-line figures;Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawingsectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing(Development of surfaces); Drawing front view, top viewand side view of objects from the givenpictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar PublishingHouse
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, PearsonEducation
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals.

CourseCoordinator HOD

U18ESCS1L1	**Problem Solving And PythonProgramminglaboratory**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	0	0	3		1.5
	Prerequisite course –NIL					
	Course Coordinator: Ms. Jayapriya. Department:-Computer Science Engineering					

COURSE OBJECTIVES:-

To enhance the practical knowledge on writing programs using Python

COURSE OUTCOMES (COs)

CO1	R	Write, test, and debug simple Python programs.
CO2	U	Understand Python programs with conditionals and loops
CO3	A	Develop Python programs step-wise by defining functions and calling them
CO4	An	Use Python lists, tuples, dictionaries for representing compound data
CO5	E	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib
CO6	C	Design a program for simple application

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3	2	3	3	2	2	2	2		2		2	2
	CO2	3	3	1	3	3	2	1	2	2	2	2		2	2
	CO3	3	3	2	2	2	2		2	2	2	2		2	2
	CO4	3	2	3	3	3	2	2	2	2	1			2	2
	CO5	3	3	3	3	2	2		2	2	1	2			

	CO6	3	3	3	3	3								2	2
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other		Project/Term Paper/ Seminar/ Internship(PR)	
						ES									
4	Approval														

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING

LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. ExSOnentiation (SOwer of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

CourseCoordinator HOD

SEMESTER – III

U18BSMA301	**Partial Differential Equations and Transformation**	**L**	**T**	**P**		**C**
	Total Contact Hours – 60	3	1	0		4
	Prerequisite course –Engineering Mathematics I& II					
	Course Coordinator: Dr.Ramya Department:-Mathematics					
COURSE OBJECTIVES:- The course should enable the student to						

- Grasp the Fourier series expansion for given periodic function in specific intervals andtheir different forms.
- Learn techniques of solving the standard types of first order and second order partialdifferential equations.
- Learn solving wave and heat equation using Fourier series.
- Understand the problems using Fourier transform and their properties.
- Understand the problems using Z - transform and their properties.

COURSE OUTCOMES (COs)

CO1	R	To remember the formulas and equations to solve the problems..
CO2	U	Understand to solve PDE and transformation techniques.
CO3	A	Apply the basics of Z – Transform in its applicability to discretely varyingfunctions, gained the skill of formulate certain problems in terms of differenceequations and solve them using the Z – Transform techniques.
CO4	An	To analysis the boundary value problems and differential equations oftwo-pointboundary value problems, boundary value problems for partial differentialequations, etc...
CO5	Ev	To evaluate the standard types of first order and second order partial differentialequations.
CO6	C	Finding Solution of difference equations using Z – Transform.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3					2			1					
	CO2	2		3					1		2				
	CO3	2			3										
	CO4	2						2		3				1	
	CO5		1												
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							

4	Approval		

UNIT I Fourier series 12 hours

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval'sIdentity – Harmonic Analysis.

UNIT II Partial Differential Equations 12 hours

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT IIIBoundary Value Problems for Partial Differential Equations 12 hours

Classifications second order linear partial differential equations – Solution of one

dimensionalwave equation – One dimensional heat equation – Steady state solution of two dimensional heatequation – Fourier series solutions in Cartesian coordinates.

UNIT IV Fourier Transform 12hours

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosinetransform – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity.

UNIT V Z – Transform and Difference Equations 12 hours

Z – Transform – Elementary properties – Inverse Z – Transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – Transform.

Text Books / Reference books

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications1993.
2. R. Haberman, Elementary Applied partial differential equations with Fourier Series andBoundary Value Problems, 4 th Ed., Prentice Hall, 1998.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 th Edition, 2001.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9 th Edition, John Willie & Sons,2006.
5. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, UniversityScience Press, Second Edition, 2010.
6. Venkataraman. M. K. "Engineering Mathematics Volume III", 13 th Edition NationalPublishing Company, Chennai, 1998.

CourseCoordinator HOD

U18PCEE301	**Electrical Circuit Analysis**	**L**	**T**	**P**		**C**
	Total Contact Hours – 60	3	1	0		4
	Prerequisite course –Basic Electrical & Electronics Engineering					
	Course Coordinator: Mrs.R.Rathika. Department:-EEE					

COURSE OBJECTIVES:-

To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to

CO1	R	Remember network theorems for the analysis of electrical circuits.
CO2	U	Understand the First and Second order electrical networks
CO3	A	Apply the theorems to solve the electrical network problems
CO4	An	Infer circuit response using Laplace transform and frequencyresponse methods.
CO5	Ev	Predict the two port network parameters.
CO6	C	To create the two port networks.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3		3		2		1			1	3	3	
	CO2	3		3	3		2					1		3	
	CO3	3	3		3		2					1		3	
	CO4	3	3		3		2					1	3	3	

	CO5	3			3		2					1		3	
	CO6	3			3		2					1		3	
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other		Project/Term Paper/ Seminar/ Internship(PR)
							PC								
4	Approval														

UNIT I Network Theorems 12 hours

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfertheorem, Reciprocity theorem, Compensation theorem.Analysis with dependent current andvoltage sources.Node and Mesh Analysis.Concept of duality and dual networks.

UNIT II Solution of First and Second order networks 12 hours

Solution of first and second order differential equations for Series and parallel R-L, R-C, R- L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT III Sinusoidal steady state analysis 12 hours

Representation of sine function as rotating phasor, phasor diagrams, impedances andadmittances, AC circuit analysis, effective or RMS values, average power and complex power.Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, IdealTransformer.

UNIT IV Electrical Circuit Analysis Using Laplace Transforms 12 hours

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform forstandard inputs, convolution integral, inverse Laplace transform, transformed network withinitial conditions. Transfer function representation. Poles and Zeros.Frequency response(magnitude and phase plots), series and parallel resonances.

UNIT V Two Port Network and Network Functions 12 hours

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters,admittance parameters, transmission parameters and hybrid parameters, interconnections of twoport networks.

Text Books

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.

References

1. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
2. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
3. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.

CourseCoordinator HOD

U18PCEE302	Analog Electronic Circuits	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Electrical & Electronic Engineering				
	Course Coordinator: Dr.T.R.Rangaswamy. Department:-EEE				

COURSE OBJECTIVES:- To understand the fundamental concepts, operation and applications of Analog Electronic Circuits

COURSE OUTCOMES (COs)

CO1	R	Recall the operation of P-N junction Diode&Zener Diode, Bjt, MOSFET, Opp-Amplifier,
CO2	U	Understand the characteristics and working of P-N junction Diode, Zener Diode, Bjt, MOSFET, Opp-Amplifiers and power amplifiers, Clipper & Clamper circuits
CO3	Ex	Solve different configurations of BJT & MOSFET and power & Operation amplifiers applications
CO4	A	Analyze the Diode circuits, Multistage & Direct Coupled amplifiers, Differential & Power amplifiers.
CO5	Ev	Criticize linear applications of Opp-Amplifiers and power amplifiers
CO6	D	Design application of Diode ,Transistor and non- linear Opp-amplifiers

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	1	3	3					1			1		3	2
	CO2	1	3	3					1			1		3	2
	CO3	1	3	3					1			1		3	2
	CO4	1	3	3					1			1		3	2
	CO5	1	3	3					1			1	3	3	2
	CO6	1	3	3					1			1	3	3	2

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

UNIT I Diode circuits 5 hours

junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

UNIT II BJT circuits 8 hours

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

UNIT III MOSFET circuits 8 hour

MOSFET structure and I-V characteristics.MOSFET as a switch. MOSFET as an amplifier:

small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

UNIT IV Differential, multi-stage and operational amplifier 8 hours

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT V Linear applications of op-amp 8 hours

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.

UNIT VI Nonlinear applications of op-amp 8 hours

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector.Monoshot.

Text Books

1. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.

References

1. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
3. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

CourseCoordinator HOD

U18PCEE303	**Electrical Machines-I**		**L**	**T**	**P**		**C**
	Total Contact Hours – 45		3	0	0		3
	Prerequisite course – Basic Electrical & Electronic Engineering						
	Course Coordinator: Mrs.Anitha. Department:-EEE						
COURSE OBJECTIVES:- To understand the fundamental concepts, operation and applications of Analog Electronic Circuits							
COURSE OUTCOMES (COs)							
CO1	R	Remember basic concepts of magnetic circuits.					
CO2	U	Understand the concepts of linear and non-linear magnetic circuits					
CO3	A	Classify Ampere Law &BiotSavart Law for magnetic fields & circuits					
CO4	An	Analyze the construction and operation of a DC machine					
CO5	Ev	Predict the characteristic of a DC machine					

CO6	C	Develop the equivalent circuit and phasor diagram oftransformer and analyze their performance													
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 2	PSO 1
2	CO1	2	1			3				2		1	2	2	1
	CO2	2	1			3				2			2	2	2
	CO3	1	3			3				2			2	3	3
	CO4	2	2			3			2	2		3	3	3	3
	CO5	2	2			3			2	2		3	3	3	3
	CO6	2	1			3			1	2					
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)		Any other	Project/Term Paper/ Seminar/ Internship(PR)
							PC								
4	Approval														

UNIT I Magnetic fields and magnetic circuits 7 hours

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law andBiotSavart Law; Visualization of magnetic fields produced by a bar magnet and a currentcarrying coil - through air and through a combination of iron and air; influence of highlypermeable materials on the magnetic flux lines.

UNIT II Electromagnetic force and torque 9 hours

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits;linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partialderivative of stored energy with respect to position of a moving element; torque as a partialderivative of stored energy with respect to angular position of a rotating element. Examples -galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.

UNIT III DC machines 8 hours

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces orshoes, air gap and armature core, visualization of magnetic field produced by the field windingexcitation with armature winding open, air gap flux density distribution, flux per pole, inducedEMF in an armature coil. Armature winding and commutation - Elementary armature coil andcommutator, lap and wave windings, construction of commutator, linear commutationDerivation of back EMF equation, armature MMF wave, derivation of torque equation,armature reaction, air gap flux density distribution with armature reaction.

UNIT IV DC machine - motoring and generation 9 hours

Armature circuit equation for motoring and generation, Types of field excitations – separatelyexcited, shunt and series. Open circuit characteristic of separately excited DC generator, backEMF with armature reaction, voltage build-up in a shunt generator, critical field resistance andcritical speed. V-I characteristics and torque-speed characteristics of separately excited, shuntand series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.

UNIT V Transformers 12 hours

Principle, construction and operation of single-phase transformers, equivalent circuit, phasordiagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests,polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phasetransformer - construction, types of connection and their comparative features, Paralleloperation of single-phase and three-phase transformers, Autotransformers - construction,principle, applications and comparison with two winding transformer, Magnetizing current,effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current,Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changingtransformers - No-load and on-load tap-changing of transformers, Three-winding transformers.Cooling of transformers.

Text Book

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education,2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBSPublishers, 2004.

References

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

CourseCoordinator HOD

U18PCEE304	**Electromagnetic Fields**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	1	0		4
	Prerequisite course –Mathematics II&Basic Electrical & Electronics Engineering					
	Course Coordinator: Dr.S.P.Vijayaragavan. Department:-EEE					

COURSE OBJECTIVES:-To gain knowledge about the theory and problems in Electromagnetic Fields.

COURSE OUTCOMES (COs)

CO1	R	To outline the concepts of static magnetic fields, Electromagnetic forces,materials and Time varying fields.
CO2	U	To understand the foundations of electromagnetism and electrostatics and theirapplications.
CO3	A	To apply the various types Maxwell's Equation in an electromagnetic fields.
CO4	An	Analyze the vector calculus for the static electric fields in standardconfigurations.
CO5	Ev	Predict magnetic forces and time varying fields
CO6	C	Develop Solution of Laplace and Poisson's equation

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3													
	CO2	3					2							3	2
	CO3	3	1							2				3	2
	CO4	3								2				3	2

	CO5	3	1							2				3	2
	CO6	3	1				2			2				3	2
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)		
							PC								
4	Approval														

UNIT I Review of Vector Calculus 6 hours

Vector algebra, addition, subtraction, components of vectors, scalar and vector multiplications, tripleproducts, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operatordel, gradient, divergence and Curlintegral theorems of vectors. Conversion of a vector from one coordinate system to another.

UNIT II Static Electric Field 9 hours

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface andVolume charge distributions. Gauss law and its applications.Absolute Electric potential, potentialdifference, Calculation of potential differences for different configurations.Electric dipole,Electrostatic Energy and Energy density.

UNIT III Conductors, Dielectrics and Capacitance 6 hours

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditionsof perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of atwo wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson'sequation, Application of Laplace's and Poisson's equations.

UNIT IV Static Magnetic Fields 6 hours

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

UNIT V Magnetic Forces, Materials and Time Varying Fields 9 hours

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.
Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module VI Electromagnetic Waves 9 hours

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Waveequation in Phasor form, Plane waves in free space and in a homogenous material. Wave equationfor a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skineffect. Poynting theorem.

Text Books

1. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Publication, 2014.
2. A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, NewDelhi, 2009.
3. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.

References

1. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
2. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.
3. W. J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
4. W. J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968.
5. E. G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press,1966.
6. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley EducationalPublishers, International Edition, 1971.

CourseCoordinator HOD

PRACTICAL

U18PCEE3L1	**Analog Electronic Circuits Laboratory**	**L**	**T**	**P**		**C**
	Total Contact Hours – 30	0	0	3		1.5
	Prerequisite course –Basic Electrical & Electronics Engineering					
	Course Coordinator :Dr.T.R.Rangaswamy. Department:-EEE					

COURSE OBJECTIVES:-

To gain the application knowledge of

- Rectifiers.
- BJT characteristics and Amplifiers.
- MOSFET Characteristics and Amplifiers
- Power Amplifiers
- OP-AMP

COURSE OUTCOMES (COs)

CO1	R	Remember the applications of Diodes &Transistors
CO2	U	Understand the characteristics of MOSFET amplifiers& BJT amplifiers
CO3	A	Classify the P,PI and PID control Applications using op-amp
CO4	An	Differentiate Inverting, Non-inverting and Differential amplifier
CO5	Ev	Production of various waveforms using Opp-amplifiers.
CO6	C	Design a circuit for Analog to Digital conversion

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1		3	2		2			3		1	3			
	CO2		3	2		2			3		1	3	2	2	3
	CO3		3	2		2			3		1	3		2	3
	CO4		3	2		2			3		1	3		2	3
	CO5		3	2		2			3		1	3		2	3

	CO6		3	2		2			3		1	3	3	2	3

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

List of Experiments

1. Diode clipping and clamping circuits
2. Rectifier Circuits
3. BJT CE,CC& CB amplifier
4. Characteristics of MOSFET
5. Differential amplifier
6. Inverting & Non inverting amplifiers
7. Differential Amplifier using OP-AMP
8. P, PI and PID controllers
9. Analog to Digital Conversion
10. Waveform generators with OP-AMP

CourseCoordinator HOD

U18PCEE3L2	**Electrical Machines Laboratory– I**	**L**	**T**	**P**		**C**
	Total Contact Hours – 30	0	0	3		1.5
	Prerequisite course –Basic Electrical &Electronics Engineering					
	Course Coordinator :Mrs.Anitha. Department:-EEE					

COURSE OBJECTIVES:-

To expose the students to the operation of D.C. machines and transformers andgive them experimental skill.

COURSE OUTCOMES (COs)

CO1	R	Recal the concepts of AC and DC machines & Transformers
CO2	U	Understand the characteristics of DC machines through conducting ofexperiments
CO3	A	Classify the load test of AC/DC machines
CO4	An	- To analyze the characteristics of transformers and AC/DC Machines through conducting ofexperiments
CO5	Ev	- Evaluate the performance of DC machines and Transformers.
CO6	C	- Plan a real time testing of AC,DC machines & transformers

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3	3		2		3	1				3	3		

	CO2	3	3		2		3	1				3		3	2
	CO3	3	3		2		3	1				3	2	3	2
	CO4	3	3		2									3	2
	CO5	3	2		2									3	2
	CO6	3	2		2							2	2	3	2

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

List Of Experiments

1. Open Circuit characteristics of DC shunt generator
2. Load characteristics of separately excited generator
3. Load characteristics of DC shunt generator
4. Load characteristics of DC shunt generator
5. Speed control of DC shunt motor
6. Swinburne's test
7. Hopkinson's test
8. Load test on single phase transformer
9. Open Circuit and short circuit test on single phase transformer
10. Sumpener's test
11. Parallel operation of single phase transformers
12. Three phase transformer connections, scott connections.
13. Field's test on DC series motor
14. Seperation of no load losses In a single phase transformer
15. Study of DC starters

CourseCoordinator HOD

SEMESTER IV

U18PCEE401	**Digital Electronics**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –Basic Electrical &Electronics Engineering					
	Course Coordinator : Dr.V.Jayalakshmi Department:-EEE					

COURSE OBJECTIVES:-

Students will be able understand working of logic gates. Design and implementCombinational and Sequential logic circuits. Design of Analog to Digital Conversion technique.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	State the Fundamentals of Digital Systems and logicfamilies

CO2	U	Classify on Combinational Digital Circuits
CO3	An	Relate the Sequential circuits and systems
CO4	A	Implement the A/D and D/A Converters
CO5	Ev	Argue the Semiconductor memories and Programmable logicdevices
CO6	D	Design and implement the logic circuits & ADC technique.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1		3	2	2							2		3	2
	CO2		3	2	2							2	3	3	2
	CO3		3	2	2							2	2	3	2
	CO4		3	2	2							2	3	3	2
	CO5	3		3	3	2				2		2		3	1
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

UNIT I Fundamentals of Digital Systems and logic families 9 hours

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations,Boolean algebra, examples of IC gates, number systems-binary, signed binary, octalhexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes,error detecting and correcting codes,characteristics of digital lCs, digital logic families, TTL,Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT II Combinational Digital Circuits 9 hours

Standard representation for logic functions, K-map representation, simplification of logicfunctions using K-map, minimization of logical functions. Don't care conditions,Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry lookahead adder,serial adder, ALU, elementary ALU design, popular MSI chips, digitalcomparator, parity checker/generator, code converters, priority encoders, decoders/drivers fordisplay devices,Q-M method of function realization.

UNIT III Sequential circuits and systems 9 hours

A 1-bit memory, the circuit properties of Bitable latch, the clocked SR flip flop, J- K-TAndtypes flipflops,applications of flip flops, shift registers, applications of shift registers, serial toparallelconverter, parallel to serial converter, ring counter, sequence generator,ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, specialcounter IC's, asynchronous sequential counters, applications of counters.

UNIT IV A/D and D/A Converters 9 hours

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter,specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit,analog to digital converters: quantization and encoding, parallel comparator A/D

converter,successive approximation A/D converter, counting A/D converter, dual slopeA/D converter,A/D converter using Voltage to frequency and voltage to time conversion, specificationsof A/D converters, example of A/D converter ICs

UNIT V Semiconductor memories and Programmable logic devices. 9 hours

Memory organization and operation, expanding memory size, classification andcharacteristics of memories, sequential memory, read only memory (ROM), read and writememory(RAM), content addressable memory (CAM), charge de coupled device memory(CCD), commonly used memory chips, ROM as a PLD, Programmable logic array,Programmable array logic, complex Programmable logic devices (CPLDS), FieldProgrammable Gate Array (FPGA).

Text book

1. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

References

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

CourseCoordinator HOD

U18PCEE402	**Electrical Machines-II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	1	0	4
	Prerequisite course –Basic Electrical & Electronic Engineering				
	Course Coordinator: Mrs.S.Anitha. Department:-EEE				

COURSE OBJECTIVES:-

To give the students a fair knowledge on the working of various AC machinesand thecharacteristics

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Memorize the type of winding in AC machines
CO2	U	Explain the fundamental knowledge of Pulsating and revolving magneticfields
CO3	An	Examine the Construction, principle of operation and performance of inductionmachines.
CO4	A	Sketch the Construction, principle of operation and performance of singlephase induction motors
CO5	Ev	Defend the Construction and performance of salient and non – salient typesynchronous generators.
CO6	C	Design procedure for synchronization and parallel operation.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 2	PSO 1
2	CO1	2	1			3				2		1		2	1
	CO2	2	1			3				2				2	1
	CO3	1	3			3			2	2			3	2	2
	CO4	2	2			3			2	2		3		3	3
	CO5	2	2			3			1	2		3	3	3	3
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

UNIT I Fundamentals of AC machine windings 9 hours

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turnoil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding,winding axis, 3D visualization of the above winding types, Air-gap MMF distribution withfixed current through winding - concentrated and distributed, Sinusoidally distributed winding,winding distribution factor.

UNIT II Pulsating and revolving magnetic fields 9 hours

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternatingcurrent, Pulsating fields produced by spatially displaced windings, Windings spatially shiftedby 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT III Induction Machines 12 hours

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting andMaximum Torque.Equivalent circuit.Phasor Diagram, Losses and Efficiency.Effectofparameter variation on torque speed characteristics (variation of rotor and stator resistances,stator voltage, frequency). Methods of starting, braking and speed control for induction motors.Generator operation.Self-excitation.Doubly-Fed Induction Machines.

UNIT IV Single-phase induction motors 5 hours

Constructional features, double revolving field theory, equivalent circuit, determination ofparameters. Split-phase starting methods and applications.

UNIT V Synchronous machines 10 hours

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalentcircuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation.Operating characteristics of synchronous machines, V-curves.Salient pole machine – tworeaction theory, analysis of phasor diagram, power angle characteristics.Parallel operation ofalternators - synchronization and load division.

Text/References

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons,2007.

CourseCoordinator HOD

U18PCEE403	Power Electronics	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –Analog Electronic circuits				
	Course Coordinator: Mrs.R.Rathika. Department:-EEE				

COURSE OBJECTIVES:-

To analyze and design the Power electronic circuits based on varioussemiconductor switches and switching characteristics

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Define various power switching devices.
CO2	U	Describe controlled thyristor rectifier circuits.
CO3	A	Sketch the operation of DC-DC choppers.
CO4	An	Organize the operation of single Phase voltage source inverters.
CO5	Ev	Appraise the operation of three Phase voltage source inverters.
CO6	C	Design power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO 2	PSO -
2	CO1	2	2	2	2	2	3					1		2	-
	CO2	3	3	3		2	2			3		2		2	-
	CO3	3	3	3			2			3		2	2	2	-
	CO4	3	3	3	2		2			3		2		2	-
	CO5	3	3	3	2		2			3		2	3	2	-
	CO6	1				2			1						

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

UNIT I Power switching devices 10hours

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage andcurrent commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT II Thyristor rectifiers 7 hours

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier withR-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load andhighly inductive load; Input current wave shape and power factor.

UNIT III DC-DC converters 10hours

Elementary chopper with an active switch and diode, concepts of duty ratio and average

voltage,power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control ofoutput voltage, Power circuit of a boost converter, analysis and waveforms at steady state,relation between duty ratio and average output voltage.

UNIT IV Single-phase voltage source inverter 10hours

Power circuit of single-phase voltage source inverter, switch states and instantaneous outputvoltage, square wave operation of the inverter, concept of average voltage over a switching cycle,bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and outputvoltage.

UNIT V Three-phase voltage source inverter 8 hours

Power circuit of a three-phase voltage source inverter, switch states, instantaneous outputvoltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

Text Books

1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science; Business Media, 2007.
2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

References

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson EducationIndia, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design",John Wiley; Sons, 2007.

CourseCoordinator HOD

U18PCEE404	**Digital Signal Processing**	**L**	**T**	**P**		**C**
	Total Contact Hours – 40	3	1	0		4
	Prerequisite course –Partial Differential Equations and Transformation& Digital Electronics					
	Course Coordinator: Mrs.S.Sherine. Department:-EEE					

COURSE OBJECTIVES:-

To gain fair knowledge of Digital Signal Processing.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Define signals mathematically in continuous and discrete-time, and in thefrequency domain..
CO2	U	Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
CO3	A	Implement the digital signal processing for the analysis of signals
CO4	An	Examine the discrete-time systems using z-transform.
CO5	E	. Evaluate the various advanced Programmable DSPs and understand the Code Composer Studio
CO6	C	Design digital filters for various applications.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	2	2		2	3				2	3		3	
	CO2	3	3	2		2	3		2			3		2	
	CO3	3				2	3				2	2		2	
	CO4	3	3	2		3	3	2	2	2	2	3	2	2	
	CO5	3	3	2		3	3	2	2	2	2	3	2	3	3

	CO6	3						1	2		2		2	2	3
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)		Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other		Project/Term Paper/ Seminar/ Internship(PR)	
							PC								
4	Approval														

UNIT I Discrete-time signals and systems 8hours

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis;Representation of discrete systems using difference equations, Sampling and reconstruction ofsignals - aliasing; Sampling theorem and Nyquist rate.

UNIT II Z-transform 8 hours

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain,Inverse z-transforms.

UNIT III Discrete Fourier Transform 10hours

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT,Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementationof Discrete Time Systems.

UNIT IV Design of Digital filters 12 hours

Designof FIR Digital filters: Window method, Park-McClellan's method. Design of IIRDigitalFilters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass,and-stop and High-pass filters.Effect of finite register length in FIR filter design. Parametricand non-parametric spectral estimation. Introduction to multi-rate signal processing.

UNIT V Applications of Digital Signal Processing 7 hours

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMAModel, Linear Mean-Square Estimation, Wiener Filter.

Text Books

1. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.
2. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms AndApplications", Prentice Hall, 1997

Reference Books

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill,2011.
2. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing",Prentice Hall, 1992.
3. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley Sons, 1988.

CourseCoordinator HOD

U18BSMA402	Probability, Statistics and Numerical Methods	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course –Engineering Mathematics 1&II				
	Course Coordinator :Dr.Manimegalai. Department:-Mathematics				

COURSE OBJECTIVES:-

The course should enable the student to

1. Learn basics of probability, Baye's Theorem. Understand the concept of random variable,moment generating functions and their properties; learn standard distributions in discreteand continuous cases.
2. Learn measures of central tendency and correlation and regressions, rank correlation,statistical intervals for single sample and test of hypothesis for a small and large sample.
3. Ability to apply knowledge of mathematics, science and engineering.
4. Ability to analyze and interpret data
5. Identify , formulate and solve equations by various methods

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Memorize the concept of numerical differentiation and integration usingTrapezoidal and Simpson's rules..
CO2	U	Discuss to Learn the basic idea of statistics including measures of central tendency.Identify the appropriate hypothesis testing procedure based on type of outcomevariable and number of samples.
CO3	A	Solveequations by Newton-Raphson and Regula-Falsi methods and system of linearequations by various methods
CO4	An	Compare the value of a dependent variable in the given data by Newton's forwardand backward difference formulae and also unequal intervals.
CO5	E	Argue the probability using addition and multiplication theorem and the moments ofdistributions using moment generating functions
CO6	C	Design and solution for engineering applications

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3			3	3			1		2			3	3
	CO2	3			3	2			1		2				
	CO3	3			3	3			1		2			3	
	CO4	3			3	3			1		2			3	
	CO5	3			3	3			1		2				
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
			BS							

4	Approval		

UNIT I Probability Distribution 12 hours

Probability – Axioms of probability – Conditional probability – Baye's theorem –Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normaldistribution and their properties.

UNIT II Statistics and Testing of Hypothesis 12 hours

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression –Rank correlation – Test of significance: Large sample test for single proportion, difference ofproportions – Chi Square test for goodness fit and independence of attributes.

UNIT III Solution of Polynomial and Transcendental Equations 12 hours

Bisection method, Newton-Raphson method and Regula-Falsi method for single variable-solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedalmethods.

UNIT IV Finite Difference and Interpolation 12 hours

Finite differences -Relation between finite difference operators- Interpolation using Newton'sforward and backward difference formulae, Interpolation with unequal intervals-Newton'sDivided difference formula, Lagrange's Interpolation formula.

UNIT V Numerical Differentiation and Integration 12 hours

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidaland Simpson's both 1/3 rd and 3/8 th rules. Double integration using Trapezoidal rule and Simpsonrule.

Text Books /References

1 1.Sastry.S. S "Introductory Numerical Methods" PHI, 2010
2 Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific andEngineering Computation" 4rd edition, 2005
3 3.Grewal, B.S. "Higher Engineering Mathematics (36th edition)" Khanna PublicationDelhi .
4 Curtis F.Gerald."Applied Numerical Analysis" 7th Edn.Pearson Education, Chennai-600113.3. Dennis G.Zill and Warren S.Wright."Advanced Engineering Mathematics".3rd Edn.Jones & Bartlett Publishers, UK.1992 4 .www.mathforcollege.com.
5 P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company,2 nd Edition 2010.

CourseCoordinator HOD

U18HSBA401	**Organizational Behavior**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	3	0	0		3
	Prerequisite course –NIL					
	Course Coordinator :Dr Praveen. Department:-Management Studies					

COURSE OBJECTIVES:-

1. Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups
4. Analyse the behaviour of individuals and groups in organizations interms of the key factors that influence organizational behaviour. Assessthe potential effects of organizational - level factors (such as structure,culture and change) on organizational behaviour.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	List the Frame work of Organizational Behaviour

CO2	U	Describe the Sources of power
CO3	A	Execute the Awareness of the Merits and Demerits of Group decision making.
CO4	An	Examine the Knowledge of the Interpersonal perception
CO5	Ev	Appraise the knowledge of types of Conflicts
CO6	C	Development of leadership including training, Power and Authority

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3								3				3	1
	CO2	2		1			3	2				1			3
	CO3			3	3			1		2			2	2	
	CO4	1					1					1		3	
	CO5	1		1											2
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
		HS								
4	Approval									

UNIT I **9 hours**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplinesinvolved in the study of Organizational Behavior, -Contributing disciplines and area – Applicationof Organizational Behavior in Business.

UNIT II **9 hours**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Groupand inter-group behaviour.

UNIT III **9 hours**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9 hours**

Leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9 hours**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications

2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan.

CourseCoordinator HOD

U18MCTH401	Universal Human Values	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –NIL				
	Course Coordinator :Ms.Aarthisuriya. Department:- EEE				

COURSE OBJECTIVES:-

The objective of the course is four fold:

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of Human relationships and resolved individuals.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE OUTCOMES (COs)

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.

They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

U18PCEE4L1	Digital Electronics lab	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite course –Basic Electrical and Electronics Lab				
	Course Coordinator :Dr.V.Jayalakshmi. Department:-EEE				

COURSE OBJECTIVES:-

To enhance the practical knowledge on Digital Electronics and to designthe experiments.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Memorize all digital electronics components
CO2	U	Classify and gain knowledge on sequential circuits.
CO3	A	Demonstrate and develop skill on Counter circuits and the Flip-Flaps
CO4	An	Differentiate comparator &amp and Universal gates
CO5	E	Predict logic and combination logic circuits for industrial applications
CO6	C	Design and will be able develop skill on AD/DA conversion techniques

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS	PS

2	CO1	1	3	3	2	2						2		O	O
	CO2	1	3	3	2	2						2	2	3	3
	CO3	1	3	3	2	2						2		3	3
	CO4	1	3	3	2	2						2		3	3
	CO5	1	3	3	2	2						2	3	3	3
	CO6	1	3	3	2	2						2		3	3

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

LIST OF EXPERIMENTS

1. Introduction to Digital Electronics lab-Nomenclature of digital ICS, 1 specifications, study ofthe data sheet, concept of vcc and ground, verification of the truth tables of logic gates usingTTL ICS.
2. Implementation of the given Boolean function using logic gates in 2 both sop and pos forms.
3. Verification of state tables of RS, JK, T and D flip-flops using 3 NAND & nor gates.
4. Implementation and verification of decoder/de-multiplexer and 4 encoder using logic gates.
5. Implementation of 4x1 multiplexer using logic gates.
6. Implementation of 4-bit parallel adder using 7483 IC.
7. Design and verify the 4-bit synchronous counter.
8. Design and verify the 4-bit asynchronous counter.
9. To design and verify operation of adder and subtractor.
10. To design and verify operation of AD/DA Converter
11. To design & verify the operation of magnitude comparator

CourseCoordinator HOD

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U18PCEE4L2	**Electrical Machines-II Laboratory**	**L**	**T**	**P**		**C**
	Total Contact Hours – 45	0	0	3		1.5
	Prerequisite course –Electrical Machines Laboratory–I					
	Course Coordinator :Mrs.s.Anitha. Department:-EEE					

COURSE OBJECTIVES:-

To expose the students to the operation of synchronous machines and inductionmotors and give them experimental skill.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Recall components of electrical machines

CO2	U	Understand the concept of operation of electrical machines
CO3	A	Execute the performance characteristics of Synchronous generators and load teston alternator.
CO4	An	Analyze the performanceof Three phase Induction motor machines and slip ringinduction motor
CO5	E	Experiment the performance of single phase Induction motor machines.
CO6	C	Plan to Synchronize and parallel operation by dark lamp, bright lamp and synchronoscope methods.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O	PS O
2	CO1	3	3	2		3	1					3		3	2
	CO2	3	3	2		3	1					3	3	3	2
	CO3	3	3	2		3	1					3	2	3	2
	CO4														
	CO5														
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)	
					PC						
4	Approval										

LIST OF EXPERIMENTS

1. Regulation of alternator by EMP and MMF method
2. Regulation of alternator by potier ASA method
3. Regulation of salient pole alternator – slip test
4. Load test on alternator
5. Study of A.C. starters
6. V and inverted V curve of synchronous motor.
7. Brake test of three phase squirrel cage induction motor.
8. No load and blocked rotor tests on three phase induction motor and circle diagram andequivalent circuit
9. Load test on single phase induction motor.
10. Equivalent circuit and predetermination of performance of single phase induction motor.
11. Load test on three phase induction motor
12. Load test on three phase slip ring induction motor
13. Synchronizing and parallel operation by dark lamp, bright lamp and synchronoscopemethods.

CourseCoordinator HOD

U18PCEE4L3	Power Electronics Laboratory	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite course –Analog Electronic Circuits				
	Course Coordinator :Mr.S. Sherine Department:-EEE				

COURSE OBJECTIVES:-

To gain fundamental knowledge about Power Electronic devices.

COURSE OUTCOMES (COs) At the end of this course, Students Will demonstrate the ability to

CO1	R	Sate the basic power switching devices
CO2	U	Explain the concept of Thyristor as rectifiers
CO3	A	Implement theconceptofDC-DC boost converter
CO4	An	Examine theconceptofDC-DC buck and boost converter
CO5	E	Apprise Single-phase and three-phasevoltage source inverter
CO6	C	Design Single-phase voltage source inverter and Threephase voltage source inverter

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO 1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3	3		2			2	2	3	3	2		3
	CO2	3	3	3		2			2	2	3	3			3
	CO3	3	3	3		2			2	2	3	3			3
	CO4	3	3	3		2			2	2	3	3			3
	CO5	3	3	3		2			2	2	3	3	3		3
	CO6														

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

List of Experiments

1. Characteristics of Thyristor
2. Characteristics of MOSFET
3. Characteristics of IGBT
4. Single-phase half-wave and full-wave rectifiers
5. Three-phase full-bridge thyristor rectifier
6. Buck Converter
7. Boost Converter
8. DC-DC boost converter
9. Single-phase voltage source inverter
10. three-phasevoltage source inverter

CourseCoordinator HOD

SEMESTER V

U18PCEE501	**POWER SYSTEMS – I(APPARATUS AND MODELING)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Electrical and Electronics Engineering				
	Course Coordinator :Dr.V.Jayalakshmi. Department:-EEE				

COURSE OBJECTIVES:-

1. To introduce the concepts and phenomenon of different sources of Power Generation.
2. To give an idea about the fundamental concepts of electrical power distribution, both AC & DC.

COURSE OUTCOMES (COs)

CO1	R	Remember the concepts of power systems.
CO2	U	Understand the working of various Components in power system, Over-voltages ,Insulation, DC power transmission and renewable energy generation
CO3	A	Apply various protection Schemes in over voltages.
CO4	An	Analyze simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.
CO5	Ev	Evaluate fault currents for different types of faults and per unit calculations in synchronous motors.
CO6	C	Design steady state, transient and sub-transient equivalent circuits

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3	3	3	3	2	2		2	1	1		3	
	CO2	3	3	3	3	3							2		3
	CO3	3	3		3	3			2						3
	CO4	3	3	3	3							1		3	
	CO5	3	3	3	3	3				2					3
	CO6	3	3			3	3	3	3		3	2	3		

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

SYLLABUS

UNIT I BASIC CONCEPTS 9 Hours

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources.Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

UNIT II POWER SYSTEM COMPONENTS 12 Hours

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables.Capacitance and Inductance calculations for simple configurations.Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power.

Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto-transformers, Neutral Grounding transformers. Tap-Changing in transformers.Transformer Parameters.Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-**UNIT** System and per-UNIT calculations.

UNIT III OVER-VOLTAGES AND INSULATION REQUIREMENTS 6 Hours

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination.Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

UNITIV FAULT ANALYSIS 9 Hours

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults.Representation of generators, lines and transformers in sequence networks.Computation of Fault Currents.Neutral Grounding.

UNIT V INTRODUCTION TO DC TRANSMISSION & RENEWABLE ENERGY SYSTEMS 9 Hours

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

TEXT BOOKS

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.

REFERENCES:

1. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

CourseCoordinator HOD

U18PCEE502	**CONTROL SYSTEMS**		**L**	**T**	**P**	**C**
	Total Contact Hours – 45		3	1	0	4
	Prerequisite – Engineering Mathematics, Electrical Circuit Analysis					
	Course Coordinator : Ms.G.HemavathyDepartment:-EEE					
COURSE OBJECTIVES:-To understand the modeling of Control systems using transfer function and state-space representations.						
COURSE OUTCOMES (COs)						
CO1	R	Recall the mathematical models of physical systems, control hardware and their models.				
CO2	U	Understand the mathematical models of physical systems, control hardware and their models,. The relationship between time and frequency response.				
CO3	A	Apply the stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems				
CO4	An	Analyze the Time Response and its stability by root locus andRouth-Hurwitz Criteria and Frequency response by Bode plot , polar plot and Nyquist criterion				
CO5	Ev	Evaluate the various parameters of time response , frequency response of control system. andModeling electromechanical applications.				
CO6	C	Create and realize the controllers and compensation techniques that can be used to stabilize				

		the control systems .													
	Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1		3	3		2			3	2		2	2	2	3
	CO2		3	3		2			3	2		2		2	3
	CO3		3	3		2			3	2		2		2	3
	CO4		3	3		2			3	2		2		2	3
	CO5		3	3		2			3	2		2		2	3
	CO6		3	3		2			3	2		2	3	2	3
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)					
					PC										
4	Approval														

SYLLABUS

UNIT I INTRODUCTION TO CONTROL PROBLEM 6 Hours

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

UNITII TIME RESPONSE ANALYSIS 10 Hours

Standard test signals. Time response of first and second order systems for standard test inputs.Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability.Routh-Hurwitz Criteria.Relative Stability analysis.Root-Locus technique.Construction of Root-loci.

UNIT III FREQUENCY-RESPONSE ANALYSIS 6 Hours

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT IV INTRODUCTION TO CONTROLLER DESIGN 10 Hours

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.Root-loci method of feedback controller design.Design specifications in frequency-domain.Frequency-domain methods of design.Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.Analog and Digital implementation of controllers.

UNIT V STATE VARIABLE ANALYSIS 7 Hours

Concepts of state variables.State space model.Diagonalization of State Matrix.Solution of state equations.Eigenvalues and Stability Analysis.Concept of controllability and observability.Pole-placement by state feedback.

Discrete-time systems.Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

UNIT VI INTRODUCTION TO OPTIMAL CONTROL AND NONLINEARCONTROL 6 Hours

Performance Indices.Regulator problem, Tracking Problem.Nonlinear system–Basic concepts and analysis.

TEXT BOOKS

1 M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2 K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
3 I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

References

1 B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

CourseCoordinator HOD

U18PCEE503	**ELECTRICAL MACHINE DESIGN**		**L**	**T**	**P**	**C**
	Total Contact Hours – 60		3	1	0	4
	Prerequisite – Electrical Machines – I & II					
	Course Coordinator: Mrs.AnithaSampathkumar. Department:-EEE					
COURSE OBJECTIVES To provide sound knowledge about constructional details and design of various electrical machines.						
COURSE OUTCOMES (COs)						
CO1	R	Remember the basic concepts in electrical machine design				
CO2	U	Understand and gain knowledge about Sizing of a transformer and temperature rise in transformers, Induction Motors and leakage reactance of polyphase machines, Sizing of a synchronous machine				
CO3	A	Apply design procedure applicable to various electrical machines.				

CO4	An	Analyze the design procedure for various electrical machines in Computer aidedDesign (CAD
CO5	Ev	Evaluate the various parameters of electrical utilities.
CO6	C	Create various Electrical machines parts in Computer aidedDesign (CAD

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2	1	3		1			1	1		1		3	2
	CO2	2	1	3		1			1	1		1	2	3	2
	CO3	2	1	3		1			1	1		1		3	2
	CO4	2	1	3		1			1	1		1		3	2
	CO5		2								2				
	CO6	2	1	3		1			1	1		1	3	3	1

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					

4	Approval	

OBJECTIVES To provide sound knowledge about constructional details and design of various electrical machines.

SYLLABUS

UNIT I INTRODUCTION 12 Hours

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II TRANSFORMERS 12 Hours

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT III INDUCTION MOTORS 12 Hours

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design

of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT IV SYNCHRONOUS MACHINES 12 Hours

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNITV COMPUTER AIDED DESIGN (CAD) 12 Hours

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

TEXT BOOKS

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

REFERENCES

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.

CourseCoordinator HOD

U18PCEE504		**MEASUREMENT AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
		Total Contact Hours – 45	3	0	0	3
		Prerequisite – Basics of Electrical and Electronic Systems				
		Course Coordinator : Dr.T.R.Rangaswamy Department:-EEE				
COURSE OBJECTIVES To understand the fundamental concepts of measuring systems and instruments.						
COURSE OUTCOMES (COs)						
CO1	R	To recall the various electrical and non-electrical parameters and their characteristics.				
CO2	U	To understand the working and functions of Transducers, advanced sensors and amplifier				
CO3	A	To Apply knowledge and handle instruments for measurement of Electrical, Optical, Thermal and Mechanical quantities.				
CO4	An	To Analyze the functioning of Electrical measurements and telemetry.				

CO5	Ev	To Evaluate signal conditioning methods for input, output and monitoring of various devices.
CO6	C	To design different sensors and devices for industrial application

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3		3		2		1			1		3	
	CO2	3		3	3		2					1		3	
	CO3	3	3		3		2					1	3	3	
	CO4	3	3		3		2					1		3	
	CO5	3			3		2					1		3	
	CO6			2			1				1				

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					

4	Approval		

SYLLABUS

UNITIINTRODUCTION **9 Hours**

Functional elements of measurement system – static characteristics – static calibration – accuracy, precision, resolution, linearity, dynamic, characteristics – performance characteristics of zero first, second order system – error in measurement.

UNIT II SENSORS AND TRANSDUCER **9 Hours**

Basic requirement of sensors – classification of sensors – resistive, inductive and capacitive transducers –LVDT, piezoelectric, thermoelectric, optical and digital transducer – transducers application in force, torque, level, flow, pressure, speed, and temperature measurement – PH electrode – photoelectric transducer.

UNIT III SIGNAL CONDITIONING SYSTEM **9 Hours**

Bridges – instrumentation amplifier – operational amplifier – buffer amplifier – differential amplifier – active filter, V/F and F/V converters, PLL, sample and hold circuit, A/D and D/A converters, function generators, multiplexing and de-multiplexing system, data acquisition system.

UNIT IV ELECTRICAL AND ELECTRONICS MEASUREMENT AND TELEMETRY 9 Hours

Principle of ammeter and voltmeter – digital voltmeter – energy meter – wattmeter – current – voltage and position telemetry system – AC telemetry – wattmeter – current, voltage and position telemetry system – AC system

UNIT V INPUT – OUTPUT DEVICES AND DISPLAYS 9 Hours

Seven segment display – LED, LCD, mixie tube, alphanumeric display – CRT, CRO – Magnetic tape recorder – digital printer – X-Y recorder .

TEXT BOOKS

1. Doebeline, E.O., "Measurement Systems – Application and Design", McGraw Hill Publishing compeney, 1990.
2. Dalley, J.W. Riely, W.F and Meconnel, K.G., "Instrumentation for Engineering Measurement", John Wiley & Sons, 1993 J.B Gupta, Measurements and Instrumentation".

REFERENCE BOOKS

1. Stout M.B., 'Basic electric Measurement, Prentice Hall of India. 1986
2. H.S. Kalsi, "Electronic instrumentation", Tata McGraw Hill Co., 1995.
3. Shawney A.K., "Electronic Instrumentation", DhanpatRai& Sons, New Delhi,2008.
4. Moorthy.D.V.S,"Transducers and Instrumentation", Prentice Hall of India Pvt Ltd 1995

CourseCoordinator HOD

U18MCTH502	**CONSTITUTION OF INDIA**		**L**	**T**	**P**	**C**
	Total Contact Hours – 24		2	0	0	0
	Prerequisite – NIL					
	Course Coordinator : Department:- AICTE					
	COURSE OBJECTIVES Students will be able to: • Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. • To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. • To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.					
	COURSE OUTCOMES (COs)					
CO1	R	Remember the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.				
CO2	U	Understand the intellectual origins of the framework of argument that informed the				

		conceptualization of social reforms leading to revolution in India.
CO3	A	Relatephilosophy of the Indian Constitution
CO4	An	To discuss about the passage of the Hindu Code Bill of 1956.
CO5	Ev	Evaluate the concept of administration and election commission.
CO6	C	Action plan for Organsation of Governance

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3					3					3		3	3
	CO2		3		2					3				2	3
	CO3														
	CO4			3	3							3		2	3
	CO5							2						2	3
	CO6	3	2	2								2			

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
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4	Approval		

SYLLABUS

UNIT I **4 Hours**

History of Making of the Indian Constitution**:** History Drafting Committee, (Composition& Working)

UNIT II **4 Hours**

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III **4Hours**

Contours of Constitutional Rights &Duties: Fundamental Rights**,** Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational

Rights,Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV **4 Hours**

Organsation of Governance: Parliament, Composition**,** Qualifications and Disqualifications**,** Powers and FPhilosophy of the Indian Constitution: Preamble, Salient Features unctions**,** Executive**,** President**,** Governor**,** Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V **4 Hours**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of ElectedRepresentativeCEO of Municipal Corporation.Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI **4 Hours**

Election Commission**:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

SUGGESTED READING

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7thEdn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

CourseCoordinator HOD

U18PCEE5L1	**POWER SYSTEMS – I LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite –Basic Electrical and Electronics Engineering				
	Course Coordinator : Dr.V.Jayalakshmi Department:- EEE				

COURSE OBJECTIVES

- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using Software tools.

COURSE OUTCOMES (COs)

CO1	R	Recall the principles and approaches behind the power system
CO2	U	To understand the Modeling of a Wind Turbine System and HVDC Transmission Line Analyzer
CO3	A	To Apply the I-V and P-V characteristics of series and parallel combination of PV
		modules.

CO4	An	To analyze the Equivalent circuit of a 3-winding transformer, Per-unit calculations, Three phase short circuit analysis in a Synchronous Machine
CO5	Ev	To Evaluate Symmetrical components of a set of Unbalanced currents and original unbalanced phase voltages from Symmetrical Components
CO6	C	Design a model for the application of renewable energy resources.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3				2			2						
	CO2	2	3			1	1		2	2		3		3	2
	CO3	2	3			1	1		2	2		3	2	3	2
	CO4	2	3			1	1		2	2		3		3	2
	CO5	3	3			1	1		2	2		3		3	2
	CO6				3		2								

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

SYLLABUS

List of Experiments

1. Voltage Regulation of a Medium Line Model
2. Calculation of ABCD Parameters for Short, Medium and Long Transmission Lines.
3. Determination of Equivalent circuit of a 3-winding transformer.
4. Per-UNIT calculations
5. Three phase short circuit analysis in a Synchronous Machine
6. Unsymmetrical Fault Analysis

7.a) Obtain Symmetrical components of a set of Unbalanced currents

b) Obtain the original unbalanced phase voltages from Symmetrical Components

8. To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules
9. To demonstrate HVDC Transmission Line Analyzer
10. Modeling of a Wind Turbine System

CourseCoordinator HOD

U18PCEE5L2	CONTROL SYSTEMS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Engineering Mathematics, Electrical Circuit Analysis				
	Course Coordinator : Ms.G.Hemavathy Department:- EEE				

COURSE OBJECTIVES

To introduce control system lab experiments using hardware and software tools which provide path towards the engineering applications.

COURSE OUTCOMES (COs)

CO1	R	To Remember the basic concepts of control system concept of AC/DC servo motor to compute the transfer function.
CO2	U	To understand the impact of P. PI &PID controllers on linear system.
CO3	A	To Apply the design concept in lead & Lag compensators and closed loop control system
CO4	An	To analyze the Synchro Transmitter and Receiver characteristics.
CO5	Ev	compare the different controller and compensator techniques and find best application
CO6	C	To Create Bode, Root Locus, Nyquistplots , using Mat lab software for control system application.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2	3			1	1		2	2		3		3	2
	CO2	2	3			1	1		2	2		3		3	2
	CO3	2	3			1	1		2	2		3		3	2
	CO4	3	3			1	1		2	2		3		3	2
	CO5				3							2			
	CO6	2	3			1	1		2	2		3		3	2

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

SYLLABUS

LIST OF EXPERIMENTS

1. Determination of transfer function parameters of a DC servo motor.
2. Determination of transfer function parameters of AC servo motor.
3. Effect of P, PI and PID controllers on second order system.
4. Digital simulation of linear systems
5. Design of lag and lead compensators.
6. Closed loop control system
7. Stability analysis of linear systems.
8. Synchro Transmitter and Receiver characteristics.
9. MATLAB programming
   a. Determination of Transfer function from poles and zeros.
   b. Determination of Poles and zeros from transfer function.
   c. Step and ramp response of first order system.
10. Simulation of second order system using MATLAB
11. Bode, Root Locus, Nyquist plots of Linear Time Invariant system using MATLAB.

CourseCoordinator HOD

U18PCEE5L3	**MEASUREMENT AND INSTRUMENTATION LABAROTARY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Basic Electrical & Electronics Engineering				
	Course Coordinator : Dr.K.SakthivelDepartment:- EEE				

COURSE OBJECTIVES

To acquire skills on using different measuring devices.

COURSE OUTCOMES (COs)

CO1	R	To remember the basic bridge technique for measurement of inductance, capacitance and resistance.

CO2	U	To understand the calibration of energy meter
CO3	A	To Apply the skill of measurement of temperature, pressure and torque using transducers.
CO4	An	To analyze the waveforms using DSO, the AC and DC bridges
CO5	Ev	Evaluate the bridge circuit with different parameters
CO6	C	Construct a new mechanism using various parameters and conditions

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3		3		2		1			1		3	
	CO2	3		3	3		2					1	2	3	
	CO3	3	3		3		2					1		3	
	CO4	3	3		3		2					1		3	
	CO5				3							2			
	CO6	2	3			1	1		2	2		3		3	2

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					

4	Approval		

SYLLABUS

LIST OF EXPERIMENT

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter
4. Measurement of L using a bridge technique as well as LCR meter.
5. Measurement of C using a bridge technique as well as LCR meter.
6. Measurement of Low Resistance using Kelvin's double bridge.
7. Measurement of High resistance and Insulation resistance using Megger.
8. Measurement of temperature using thermocouple and RTD.
9. Measurement of displacement using LVDT
10. Design of Instrumentation amplifiers.

11. Measurement of Torque and angle.
12. Calibration of single phase energy meter
13. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
14. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
15. Usage of DSO to capture transients like a step change in R-L-C circuit.
16. Current Measurement using Shunt, CT, and Hall Sensor.

CourseCoordinator HOD

SEMESTER VI

U18PCEE601	**POWER SYSTEMS – II (OPERATION AND CONTROL)**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System -I				
	Course Coordinator : Dr.V.Jayalakshmi Department:-EEE				

COURSE OBJECTIVES To gain fundamental knowledge of power system operation and its Control using various devices.

COURSE OUTCOMES (COs)

CO1	R	Remember the concepts of synchronous grid,
CO2	U	Understand the structure of a Power System and techniques to control power flows, frequency and voltage.
CO3	A	Apply numerical methods to analyze a power flow system.
CO4	An	Analysis of Power Flows, swing equation etc. Learn & analyze the Security Analysis, Contingency Analysis.
CO5	Ev	Evaluate Computational Issues in Power Systems.
CO6	C	Perform system state estimation and explore its importance. Planning to implement the optimal unit commitment (UC) under various conditions.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2	3	3		2			3	2		2	2	2	3
	CO2	3	3	3		2			3	2		2		2	3

	CO3	2	3	3		2			3	2		2		2	3
	CO4	2	3	3		2			3	2		2		2	3
	CO5	3	3	3		2			3	2		2		2	3
	CO6		3	3		2			3	2		2	3	2	3
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)					
					PC										
4	Approval														

SYLLABUS

UNIT I POWER FLOW ANALYSIS 9 Hours

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

UNIT II STABILITY CONSTRAINTS IN SYNCHRONOUS GRIDS 9 Hours

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th} order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

UNIT III CONTROL OF FREQUENCY AND VOLTAGE 9 Hours

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing.Automatic Generation Control.Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.Power flow control using embedded dc links, phase shifters and

UNIT IV MONITORING AND CONTROL 9 Hours

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement UNITs and Wide-Area Measurement Systems.State-estimation.System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis.Preventive Control and Emergency Control.

UNIT V POWER SYSTEM ECONOMICS AND MANAGEMENT 9 hours

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services.Regulatory framework.

TEXT BOOKS

1. Olle I. Elgerad, "Electric Energy System Theory and Introduction", Tata McGraw Hill publishing company, New Delhi, 2nd edition, 2004.
2. Allen J.Wood, Bruce F. Wallenberg, "Power Generation, operation and control", 2nd edition, John Wiley and sons, 2008.

REFERENCE BOOKS

1. D.P.Kothari and I.J.Nagrath, " Modern Power System Analysis" Tata McGraw Hill publishing company Ltd., 2003.
2. PrabhaKundur, "Power System Stability and Control" Tata McGraw Hill publishing company Ltd., 2006.
3. A.K.Mahalanbias, D.P.Kothari&S.I.Ahson, "Computer Aided Power System Analysis and Control" Tata McGraw Hill publishing company, New Delhi, 1990.
4. P.S.R. Murty, "Operation and Control in Power Systems" BS Publications, 2005.

CourseCoordinator HOD

U18PCEE602	**MICROPROCESSOR & MICROCONTROLLER**		**L**	**T**	**P**	**C**
	Total Contact Hours – 45		3	0	0	3
	Prerequisite – Digital Electronics					
	Course Coordinator : Dr.S.P.Vijayaragavan Department:-EEE					
COURSE OBJECTIVES An **a**bility to understand the assembly language programming, interfacing Design of peripherals like I/O, A/D, D/A, timer etc. Develop systems using Different microcontrollers.						
COURSE OUTCOMES (COs)						
CO1	R	Remember embedded system& its features				
CO2	U	Understand the concept of Microprocessors, Microcontroller(8051) and its peripheral interfacing.				
CO3	A	Apply knowledge and demonstrate programming proficiency using the various addressing Modes and data transfer instructions of the target microprocessor and microcontroller.				
CO4	An	Analyze microcontroller based system design for various applications.				
CO5	Ev	Evaluate the accepted standards and guidelines to select appropriate Microprocessor and Microcontroller to meet specified performance requirements				
CO6	C	Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.				
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-						

	Medium, 1-Low														
1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2	2	2	2	1	1		1	1		2		3	2
	CO2	2	2	2	2				1	1		2	3	3	2
	CO3	1	2	3	1				3	2		1		3	2
	CO4	1	2	3	1		1		3	2	2	1		3	2
	CO5	1	1	1	1				2	1		1		3	2
	CO6	1	2	3	1				3	2		1	3	3	2
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other		Project/Term Paper/ Seminar/ Internship(PR)	
							PC								
4	Approval														

SYLLABUS

UNIT I FUNDAMENTALS OF MICROPROCESSORS 7 Hours

Fundamentals of Microprocessor Architecture.8-bitMicroprocessor and Microcontrollerarchitecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers.Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.Overview of the 8051 family.

UNIT II THE 8051 ARCHITECTURE 8 Hours

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

UNIT III INSTRUCTION SET AND PROGRAMMING 8 Hours

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers.Programming and debugging tools.

UNIT IV MEMORY AND I/O INTERFACING 8 Hours

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices.

UNIT V EXTERNAL COMMUNICATION INTERFACE 6 Hours

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT VI APPLICATIONS 8 Hours

LED, LCD and keyboard interfacing.Stepper motor interfacing, DC Motor interfacing, and sensor interfacing, waveform generation.

TEXT BOOKS

1. M .A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
3. R. Kamal, "Embedded System", McGraw Hill Education,2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

REFERENCES

1. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.
2. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

CourseCoordinator HOD

U18PCEE603	FUZZY LOGIC AND NEURAL NETWORK	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Engineering Mathematics II				
	Course Coordinator : Dr.T.R.Rangaswamy Department:-EEE				

COURSE OBJECTIVES To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems.

COURSE OUTCOMES (COs)

CO1	R	Comprehend the fuzzy logic and the concept of fuzzinessinvolved in various systems and fuzzy set theory
CO2	U	Understand appropriate learning rules for each of the architectures.
CO3	A	Applying several neural network paradigms.Apply the conceptual things to the real world Electrical and electronics problems and applications.
CO4	An	Analysis of Competitive and Special Neural Networks

CO5	Ev	Describe the artificial intelligent techniques and interprets its data	
CO6	C	Develop some familiarity with current research problems and research methods in fuzzy and neural Techniques.	

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3	3	3	3	3	3	3	3		3	1		3	3
	CO2		3	3	3	3		3	3	3	3	1		3	
	CO3		3			3	3	1	3	3		1	3	3	
	CO4		3	3		3	3	1	3	3	1	3		3	
	CO5				3							3			
	CO6	3	3	3	3	3		3				1	3	1	3

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

SYLLABUS

UNITI FUNDAMENTALS OF FUZZY LOGIC 9 Hours

Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-union- intersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems

UNITII ARCHITECTURE OF NEURAL NETWORKS 9 Hours

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations functions- Basic learning rules- McGulloch-Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb'srule- algorithm -perceptron - Convergence theorem-Delta rule

UNIT III BASIC NEURAL NETWORK TECHNIQUES 9 Hours

Back propagation neural net:standard back propagation-architecture algorithm- derivation of learning rules-number of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine

UNIT IV COMPETITIVE NEURAL NETWORKS 9 Hours

Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2

UNIT V SPECIAL NEURAL NETWORKS 9 Hours

Cognitron and Neocognitron- Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems

TEXT BOOKS:

1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.

REFERENCEBOOKS:

1. Bart Kosko, "Neural network and Fuzzy System" - Prentice Hall-1994
2. J.Klin and T.A.Folger, "Fuzzy sets" University and information- Prentice Hall -1996
3. J.M.Zurada, "Introduction to artificial neural systems"-Jaico Publication house,Delhi 1994
4. VallusuRao and HayagvnaRao , "C++ Neural network and fuzzy logic"-BPB and Publication, New Delhi,1996

CourseCoordinator HOD

U18PCEE6L1	**POWER SYSTEMS-II LABORATORY**		**L**	**T**	**P**	**C**
	Total Contact Hours – 30		0	0	3	1.5
	Prerequisite – Power system-I Laboratory					
	Course Coordinator : Dr.V.Jayalakshmi Department:- EEE					
COURSE OBJECTIVES ➢ To enhance the practical knowledge on power systems through simulation of load flow, economic load dispatch etc. using various soft ware's like ETAP, MATLAB etc.						
COURSE OUTCOMES (COs)						
CO1	R	Understand and remember the parameters of the Power System Network				
CO2	U	Experiment with the basic load flow analysis methods				
CO3	A	Apply the load flow technique with different methods(Newton Raphson, Gauss – seidel, Fast decoupled).				
CO4	An	Analyze the load frequency control of various network systems				
CO5	Ev	Evaluate the load flow, optimal dispatchusing MATLAB software.				
CO6	C	Formulate the bus impedance &admittance matrix by different transformation method.				

	Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	3				2			2						
	CO2	2	3			1	1		2	2		3		3	2
	CO3	2	3			1	1		2	2		3	2	3	2
	CO4	2	3			1	1		2	2		3		3	2
	CO5	3	3			1	1		2	2		3		3	2
	CO6				3		2								
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)		Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)			
											PC				
4	Approval														

LIST OF EXPERIMENTS FOR POWER SYSTEMS-II LAB

1. Formulation of the bus admittance matrix by direct inspection and SingularTransformation method.
2. Formation of bus impedance matrix by direct inspection and SingularTransformation method.
3. Load Flow studies by Gauss – seidelmethods
4. Load Flow studies by Newton Raphson methods.
5. Load Flow studies by Fast decoupled methods.
6. Numerical Integration of Swing equation.
7. The Equal-Area Criterion.
8. Economic/Optimal Load Dispatch.
9. Load Frequency Control

CourseCoordinator HOD

U18PCEE6L2	MICROPROCESSORS&MICROCONTROLLERS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	3	1.5
	Prerequisite – Digital Electronics				
	Course Coordinator : Dr.S.P.Vijayaragavan Department:- EEE				

COURSE OBJECTIVES

- To gain knowledge in programming microprocessor and microcontroller and to learn about various Interfacing concepts.

COURSE OUTCOMES (COs)

CO1	R	Remember the instruction set, addressing modes of microprocessor and microcontroller
CO2	U	Understand the basic concepts of ALP.
CO3	A	Apply the assembly level programming for real time projects.
CO4	An	Analyzing ability to compare Processor & Controller.
CO5	Ev	Designing Mini projects with processors & controllers.
CO6	C	To Develop an ability in interfacing a microprocessor and microcontroller with electrical and electronic systems

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1	2	3	1					2	2		3		3	2
	CO2	2	3	1					2	2	2	3		3	2
	CO3	2	3	1	1				2	2		3	3	3	2
	CO4	2	3	1		1			2	2		3		3	2
	CO5	2	3	1					2	2		3	3	3	2
	CO6				3		2				2				

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
									PC	
4	Approval									

LIST OF EXPERIMENTS:

8085 Programming

1	(a)	8 bit Addition.	(b)	8 bit Subtraction.
2	(a)	Multiplication.	(b)	Division.
3	(a)	16 bit Addition	(b)	16 bit Subtraction.
4	(a)	Largest Element in an array.	(b)	Smallest Element in an array.
5	(a)	Ascending order.	(b)	Descending order.

8085 Interfacing

6. Traffic Light control
7. Keyboard Interface.
8. 8251 USART interface

8051 Programming

1. Demonstration of basic instructions with 8051 micro controller execution including Conditional jumps, looping and calling subroutines.

8051 Interfacing

10. Stepper motor control.
11. A/D & D/A Interface.
12. Waveform Generation

CourseCoordinator HOD

SEMESTER VII

U18PCEE701	**SMART GRID**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power Systems-I				
	Course Coordinator : Dr.S.Prakash Department:-EEE				

COURSE OBJECTIVES To enable the students acquire knowledge on smart grid, different options of architectural design and communication technology for various aspects of smart grid , System analysis and stability analysis in smart grid, renewable energy sources and storage integration with smart grid.

COURSE OUTCOMES (COs)

CO1	R	Remember the concepts and design of Smart grid
CO2	U	Understand the various communication and measurement technologies in smart grid.
CO3	A	Apply the smart grid integration technologies in real time
CO4	An	Analyzethe stability of smart grid.
CO5	Ev	Evaluate the high performance computing techniques for Smart Grid applications
CO6	C	Compiles different smart grid technologies and Summaries it

	Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1		2	2		2				2	3	2		3	3
	CO2	3	2	2							3	2	3	3	3
	CO3	3	2	2							3	2		3	3
	CO4		3	3	2	2	1			2		1		3	3
	CO5		3	3	2								3	3	3
	CO6				2										

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					PC					
4	Approval									

SYLLABUS

UNIT I INTRODUCTION TO SMART GRID 9 Hours

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT II SMART GRID TECHNOLOGIES 9 Hours

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNITIII SMART METERS 9 Hours

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement UNIT(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9 Hours

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING 9 Hours

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN),Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TEXT BOOK:

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.

REFERENCES

1. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids, 2011.
2. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions",CRC Press 2012.
3. https://www.youtube.com/watch?v=JwRTpWZReJk&list=PLzcxA4YJjE1s6NOlhCA34vrsFCeokjs9_
4. https://iit.edu/news/iittoday/?tag=smart-grid

CourseCoordinator HOD

U18MCTH701	**ESSENCE OF INDIA KNOWLEDGE TRADITION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	2	2	0	0
	Prerequisite – NIL				
	Course Coordinator : Department:-EEE				

Objective:

- It will also focus on Indian philosophical, linguistic and artistic traditions, along with yoga and Indian perspective of modern scientific worldview.
- The course aims at imparting basic principles of thought process, reasoning and inferencing.

CourseCoordinator HOD

U18PCEE7L1	Electronics Design Lab	L	T	P	C
	Total Contact Hours – 30	0	0	4	2

Prerequisite – Analog Electronics Circuits, Digital Electronics, Power Electronics

Course Coordinator : Dr.S.Prakash & Dr. T.R.Rangaswamy
Department:- EEE

COURSE OBJECTIVES

To enhance the practical knowledge on Electronic Design for Industrial Applications through experiments and simulations

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COURSE OUTCOMES (COs)

CO1	R	To recall the concept of Digital & Analog Electronics
CO2	U	To interpret and understand the Power Electronics Components
CO3	A	To classify analog and digital electronics components
CO4	An	To differentiate real time and simulation of Electronic Design applications
CO5	Ev	Choose appropriate components, software and hardware platforms
CO6	C	To Develop an electronic systems and interface with microprocessor / microcontroller

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
2	CO1		3	3	1	1				2		3		3	2
	CO2		3	2	1					2		3		3	2
	CO3		3	3	1					2		3	3	3	2
	CO4		3	2	1	1				2		3		3	2
	CO5		3	2	2					2		3	3	3	2
	CO6		3	3	2	1				2		3	3	3	3

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
									PC	

4	Approval	

LIST OF EXPERIMENTS:(Selection Based)

1

a. Design of IGBT based single phase PWM inverter.
b. Design IGBT based three phase PWM inverter.
c. Design if Single Phase AC Voltage controller with R & RL Load.
d. Design and Simulation of dc-dc converters.
e. Design of Switched Mode Power Supply.
f. Design DSP based Stepper Motor Controller using 8051 Micro-controller.

2. Programmable logic Controller (PLC) design
3. Analog and digital system design and analysis
4. Computer aided design and simulation
5. Electrical substation design
6. Design of Automation and control of Industrial process
7. Design of signal conditioning circuits;
8. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application

Course Coordinator HOD

LIST OF ELECTIVES

PROGRAM ELECTIVE –1

U18PEEE11	**Power System Protection**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System-I				
	Course Coordinator Dr.V. Jayalakshmi. Department:EEE				

OBJECTIVES To understand the analysis of Transmission Line and Wave Propagation at different Load conditions.		
COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	To Remember the components used in protection system.
CO2	U	To understand the principle of different components of a protection system and fault current due to different types of fault in a network and over current protection
CO3	A	To Apply protection schemes in the power systems.
CO4	An	To Analyze the Modeling and Simulation of Protection Schemes
CO5	E	Evaluate of components used for power system protection
CO6	C	Design Digital protection system using software tool

SYLLABUS

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO2
2	CO1		2	1		2			3	3		3		1	2
	CO2			2		1			2	3	1			1	2
	CO3				2		2							1	2
	CO4		1	1		2					2		2	1	2
	CO5			1	1		2					2		1	2
	CO6		2	1		2			3	3		3	1	1	2
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

UNIT I Introduction and Components of a Protection System 9 Hours

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

UNIT II Faults and Over-Current Protection 9 Hours

Review of Fault Analysis, Sequence Networks. Introduction to Over current Protection and over current relay co-ordination.

UNIT III Equipment Protection Schemes 9 Hours

Directional, Distance, Differential protection.Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

UNIT IV Digital Protection 9 Hours

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

UNIT V Modeling and Simulation of Protection Schemes 9 Hours

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

UNIT VI System Protection 9 Hours

Effect of Power Swings on Distance Relaying.System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text

1. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
2. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
3. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

References

1 J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.

2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.

3. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16

U18PEEE12	**Line-Commutated and Active PWM Rectifiers**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite – Power Electronics				
	Course Coordinator – Ms.S.Sherine ,Department: EEE				

OBJECTIVES

- At the end of this course, students will demonstrate the ability to Analyse controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations regeneration modes and lagging, leading and unity power factor.
- Understand the operation of PWM rectifiers – operation in rectification and mode.

COURSE OUTCOMES (COs)

CO1	R	To remember thediode, thyristor and converters.
CO2	U	To understand the operation of rectifier circuits.
CO3	A	To apply the power devices in drives.
CO4	An	To analyze about the converter operations.
CO5	E	To evaluate the rectification and regeneration modes in PWM rectifiers
CO6	C	To create the phasordiagramsand closed-loop control structure.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	H	i	j	k	l	PSO1	PSO2
2	CO1		2	2								2		2	1
	CO2		2	2								2		2	1
	CO3		2	2								2	1	2	1
	CO4		2	2								2		2	1
	CO5		2	2								2		2	1
	CO6		2	2								2		2	1
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT 1 Diode rectifiers with passive filtering 6 Hours

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

UNIT II Thyristor rectifiers with passive filtering 6 Hours

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave shape

.

UNIT III Multi-Pulse converter 6 Hours

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

UNIT IV Single-phase ac-dc single-switch boost converter 6 Hours

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

UNIT V Ac-dc bidirectional boost converter 6 Hours

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

UNIT VI Isolated single-phase ac-dc fly back converter 10 Hours

Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure

Text / References

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2001.

U18PEEE13	**UTILIZATION OF ELECTRICAL ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 42	3	0	0	3
	Prerequisite – Basic Electrical and Electronics Engineering & Power system I				
	Course Coordinator : Ms. G.Hemavathy. Department:EEE				

OBJECTIVES The objective of this course is to train students on characteristics of various drives, Heating, Welding methodologies, Illumination methods and traction system

COURSE OUTCOMES (COs)		
CO1	R	To rememberabout an electrical drives & its techniques, various types of loads.
CO2	U	To understand about the different types of electric heating.
CO3	A	To apply electrical energy in electric welding's and its various methods.
CO4	An	To analyze about the basic concept of illumination, light control and its types.
CO5	E	To evaluate the basic concepts of electric drivesinelectric traction.
CO6	C	To design lighting and flood lighting requirement

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO2
2	CO1	2				2				2		2	2	2	
	CO2					2			2	2		2		2	
	CO3					2			2	2		2		2	
	CO4					2			2	2		2		2	
	CO5					2			2	2		2		2	
	CO6	2				2			2	2		2		3	
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I Electric Drives 12 Hours

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization.

UNIT II Electric Heating 12 Hours

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT III Electric Welding 12 Hours

Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT IV Illumination Fundamentals & Various Illumination Methods 12 Hours

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT V Electric Traction 12 Hours

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking, Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption forgiven run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

Text Books

1. J.B. Gupta, "Utilization of Electric Power and ElectricTraction", Kataria& Sons publishers, Delhi, IX
Edtion, 2004.(Units 1-5)
2. C.L. Wadhwa, "Generation, Distribution and Utilization ofelectrical Energy", New Age International
(P) LimitedPublishers, 3rd Edition, 2010. (Units 1-5)

References

1. N.V. Suryanarayana, "Utilization of Electrical Powerincluding Electric drives and Electric traction",
New AgeInternational (P) Limited Publishers, 1st Edition, 1994.
2. E. Open Shaw Taylor, "Utilization of Electric Energy", OrientLongman, 1st Edition, 1937.

U18PEEE14	SPECIAL ELECTRICAL MACHINES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Electrical Machines I&II				
	Course Coordinator : Dr.S.Prakash. Department: EEE				

OBJECTIVES The student gains detailed skills related to the subject of special type of electrical machines.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	To Remember the principle of operation of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors
CO2	U	To understand construction of operation of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors
CO3	A	To demonstrate special electrical machines characteristics
CO4	An	To analyze the performance of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors.
CO5	E	To evaluate the performance of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors
CO6	C	To study the construction and design of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PS O2
2	CO1	2	1	1					1		3	2		1	2
	CO2	3	1	1		3	2		1		3	2		1	2
	CO3	1	2	1			3		1	2	3	2	2	1	2
	CO4	1	1	2			3		1		2	2		1	2
	CO5		1	1					1		2	2	1	1	2
3	Category	**PROGRAM ELECTIVE**(PE)													
4	Approval														

SYLLABUS

UNITI Synchronous Reluctance Motors 9 Hours

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT II Stepping Motors 9 Hours

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed loop control.

UNIT III Switched Reluctance Motors 9 Hours

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Senseless operation –Closed loop control of SRM - Characteristics.

UNIT IV Permanent Magnet Brushless D.C. Motors 9 Hours

Constructional features of PMBLDC Motor - Permanent Magnet materials – Magnetic Characteristics –Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power converters – Motor characteristics and control.

UNIT V Permanent Magnet Synchronous Motors 9 Hours

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sine wave motor with practical windings – Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

TEXT BOOKS

1.T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.
3. Venkataraman,"Special Electrical machines".

REFERENCES

1. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor

PROGRAM ELECTIVE –2

U18PEEE21	**HVDC Transmission Systems**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite – Power Systems – I & II				
	Course Coordinator: Dr.S. Prakash Department:EEE				

OBJECTIVES

At the end of this course, students will demonstrate the ability to understand the advantages of DC transmission over AC transmission.

COURSE OUTCOMES (COs)		
CO1	R	To remember the basics of DC power transmission.
CO2	U	To Understand the operation of Line Commutated Converters and Voltage Source Converters.
CO3	A	To demonstrate converters for HVDC system
CO4	An	To analyze the control strategies used in HVDC transmission system.
CO5	E	To evaluate the modern trends in HVDC technology.
CO6	C	To create and analyze the multi terminal DC Systems.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PS O2
2	CO1		2	1	2	1	3	3				3		3	2
	CO2	2	2		1			3			3			2	1
	CO3			1	2	2		3			3		1	2	1
	CO4		2	2	2			3			3	3		2	1
	CO5	2	1	2	2							3	2	2	1
	CO6	3	2	2	2			3			3	3		3	3
3	Category	**PROGRAM ELECTIVE** (PE)													
4	Approval														

SYLLABUS

UNIT I DC Transmission Technology 4 Hours

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability).Application of DC Transmission.Types of HVdc Systems.Components of aHVdc system. Line Commutated Converter and Voltage Source Converter based systems.

UNIT II Analysis of Line Commutated and Voltage Source Converters 10 Hours

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters.Inverter Operation.Effect of Commutation Overlap.Expressions for average dc voltage, AC current and reactive power absorbed by the converters.Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

UNIT III Control of HVDC Converters 10 Hours

Principles of Link Control in aLCCHVdc system. Control Hierarchy, Firing Angle Controls– Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers.Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

UNIT IV Components of HVDC systems 8 Hours

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects.Insulators, Transient Over-voltages.dc line faults in LCC systems. dc line faults in VSC systems. DC breakers.Monopolar Operation.Ground Electrodes.

UNIT V Stability Enhancement using HVDC Control 4 Hours

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Powe Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/DC systems.

UNIT V MTDC Links 4 Hours

Multi-Terminal and Multi-Infeed Systems.Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology.Introduction to Modular Multi-level Converters.

Text/Reference Books

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

U18PEEE22	**Solid State DC Drives**	**L**	**T**	**P**	**C**
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Electrical Machines I, Power Electronics				
	Course Coordinator: Ms.Sherine Department:EEE				

OBJECTIVES

- To study and understand the operation of DC drives and intelligentcontroller for drives.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the characteristics of dc motors.
CO2	U	Understand the concept of converter and chopper fed drives
CO3	A	To apply the characteristics of dc motors using digital control
CO4	An	To analyze the DC Drives in closed loop control
CO5	E	To Evaluate four quadrant operations of Class A, B, C, D, E chopper
CO6	C	To design closed loop control systems

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2	2	1	2
	CO4		1	1					1		3	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2		3	3
3	Category	**PROGRAM ELECTIVE**(PE)													
4	Approval														

SYLLABUS

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard co+ntrol – Constant torque and constant horse power operation – Introduction to high speed drives and modern drives. Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – stability of drives – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER CONTROL 9

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III CHOPPER CONTROL 9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control – Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV CLOSED LOOP CONTROL 9

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements – Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT V DIGITAL CONTROL OF D.C DRIVE 9

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and current sensing circuits.

TOTAL: 45 PERIODS

REFERENCES

1. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Yersy, 1989.
2. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
3. GobalK.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009
4. VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
5. P.C Sen "Thyristor DC Drives", John wiely and sons, New York, 1981.

	Distributed generation and Micro grid	**L**	**T**	**P**	**C**
U18PEEE23	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Power system I & II				
	Course Coordinator: Dr.K.Sakthivel Department:EEE				

OBJECTIVES

- To illustrate the concept of distributed generation ,the impact of grid integration and concept of Micro grid and its configuration

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the standards of generation and Microgrid
CO2	U	Understand the concept of distributed generation, operation and principle of micro grid
CO3	A	To apply the concept of distributed generation ,the impact of grid integration and concept of Microgrid and its configuration
CO4	An	To analyze the operation and principle of micro grid
CO5	E	To Evaluate the operation and principle of micro grid

CO6	C	To design control system for Micro Grid

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2	2	1	2
	CO4		1	1					1		2	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2	1	2	3
3	Category	**PROGRAM ELECTIVE** (PE)													
4	Approval														

SYLLABUS

UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages, Energy crises, Non - conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, Power Electronics interfaces in DC and AC micro grids.

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, micro grid communication infrastructure, Power quality issues in micro grids, regulatory standards, Micro grid economics, Introduction to smartmicro grids.

REFERENCES

1. AmirnaserYezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.

2. DorinNeacsu,"Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki,"Solar Photo Voltaics", , PHI learning Pvt. Ltd., New Delhi, 2009
4. J.F. Manwell, J.G "Wind Energy Explained, Theory Design and Applications,".McGowan Wiley publication, 2nd Edition, 2009.
5. D. D. Hall and R. P. Grover,"BiomassRegenerable Energy", , John Wiley, New York, 1987.
6. John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2006.

U18PEEE24	**MICROCONTROLLER BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Microprocessor & Microcontroller				
	Course Coordinator: Dr.S.P.Vijayaraghavan Department:EEE				

OBJECTIVES

To expose the students to the fundamentals of microcontroller based system design

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the basics of embedded system
CO2	U	Understand about Hardware/software co-design aspects andARM Processor and programming them.
CO3	A	To apply the concept of embedded system in ARM Processor
CO4	An	To analyze various interfacing circuits necessary for various applications
CO5	E	Criticize PIC controller and Arm processor
CO6	C	To Create Hardware/software co-design aspects

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2	2	1	2
	CO4		1	1					1		2	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2		3	3
3	Category	**PROGRAM ELECTIVE** (PE)													
4	Approval														

SYLLABUS

UNIT I EMBEDDED SYSTEMS 9

Introduction to embedded systems – hardware and software components –types- examples-characteristics –system on chip-challenges in embedded computing system design – embedded system design process.

UNIT II EMBEDDED SYSTEM INTERFACING 9

Serial and parallel communication devices-wireless devices – timer & counting devices-Watch dog timer – Serial communication using I2C- CAN USB buses –Parallel Communication using ISA- PCI- PCI/X buses-wireless and mobile system protocol.

UNIT III ARM PROCESSOR-7 **9**

MSP430 architecture-addressing modes-constant generator and emulsion instructions-instruction set, functions- interrupts low power modes.

UNIT IV PIC CONTROLLER **9**

PIC microcontrollers: History and features –Architecture – memory organization – addressing modes – instruction set – PIC progrmming –I/O port, Data Conversion, RAM & ROM Allocation.

UNIT V INTERFACING – CASE STUDY **9**

Interfacing PIC to LCD – Keyboard– parallel and serial ADC, DAC– Stepper motor interfacing.

TEXT BOOKS

1. Sriram. V.Iyer& Pankaj Gupta, "Embedded real time systems Programming", Tata McGraw- Hill, 2007.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008 .
3. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000

REFERENCES

1. Rajkamal, "Embedded system-Architecture, Programming and Design", 2nd edition Tata McGraw-Hill, 2003.
2. John H. Davies, "MSP430 Microcontroller Basics", Newnes publishers, First edition, 2008.
3. Rafiquzzaman**.**M**,** "Microcontroller Theory and Applications with the PIC18F", Wiley 2011.
4. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home1_1.htm

PROGRAM ELECTIVE – 3

U18PEEE31	**High Voltage Engineering**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite –Power system I&II				
	Course Coordinator: Ms.Anitha Sampathkumar Department:EEE				

OBJECTIVES To gain the knowledge on various issues related to power system equipment's and to take up the suitable measures for fault protection.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	To Remember Electrical System Components
CO2	U	ToUnderstand generation of High Voltage, insulation and Measurement of D. C., A.C., & Impulse voltages.
CO3	A	To Apply the safe methods in power generation and transmission
CO4	An	To Analyze the high voltages and currents in power system components
CO5	E	To Evaluate High Voltage Testing of Electrical Apparatus and High Voltage Laboratories
CO6	C	Design High voltage laboratory layout, indoor and outdoor

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	1		1	2	1								2	--
	CO2	1		1		2	2	2		1				2	--
	CO3	2		1		1	3			1				2	--
	CO4	2		1	2	1	2		1	1		1		3	3
	CO5	1		1	2	1	1	2		1		1		3	3
	CO6	1		2										3	3
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I Breakdown in Gases, liquid and solid Insulating materials 15 Hours

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge, Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT II Generation of High Voltages 7 Hours

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT III Measurements of High Voltages and Currents 7 Hours

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT IV Lightning and Switching Over-voltages 8 Hours

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT V High Voltage Testing of Electrical Apparatus and High Voltage Laboratories 8 Hours

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text books

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Reference Books

1. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
3. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
4. Various IS standards for HV Laboratory Techniques and Testing.

U18PEEE32	**Solid State AC Drives**	**L**	**T**	**P**	**C**
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Electrical Machines I , Power Electronics				
	Course Coordinator: Ms Hemadhavi Department:EEE				

OBJECTIVES

To study and understand the operation of Induction motor drives and Synchronous motor drives.

COURSE OUTCOMES (COs)		
CO1	R	To remember basics of AC Motor.
CO2	U	To understand Rotor, Voltage and frequency control and Slip Power Recovery Scheme
CO3	A	To apply Rotor, Voltage and frequency control in AC Drives
CO4	An	To analyze AC Motor Drives
CO5	E	To predict Rotor and stator characterictics
CO6	C	To Design slip power recovery scheme

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2	2	1	2
	CO4		1	1					1		3	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2	2	3	3
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I STATOR VOLTAGE CONTROL OF INDUCTION MOTOR 9

Torque, slip characteristics, operation with different types of loads, performance comparison of different AC power controllers speed reversal, closed loop control.

UNIT II STATOR FREQUENCY CONTROL 9

Operation of induction motor Non-Sinusoidal supply waveforms, Variable frequency, operation of 3 phase induction motor, constant flux operation, current fed operation dynamic and regenerative braking of CSI and VSI fed drives.

UNIT III ROTOR RESISTANCE CONTROL 9

Torque, slip characteristics, types of rotor choppers, torque equation, constant torque operation, TRC strategy, combined stator voltage control and rotor resistance control.

UNIT IV SLIP POWER RECOVERY SCHEME 9

Torque equation, torque – slip characteristics-power factor consideration, Sub-Synchronous operation closed loop control.

UNIT V SYNCHRONOUS MOTOR DRIVES 9

Need for leading pf operation –open loop VSI fed and its characteristics –self-control torque angle control –power factor control- Brushless excitation systems staring, principles of vector control

Total Periods: 45

REFERENCES

1. Dubey, G.K. ‘’Power Semiconductor controlled drives’’, Prentice Hall international, New Jersey,1989
2. Dewan, S.B. Slemon, G.R. Straughen, ‘’A Power Semiconductor Drives’’ John Wiley and Sons New York, 1984

U18PEEE33	**Energy Management & SCADA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 42	3	0	0	3
	Prerequisite –Power System I&II				
	Course Coordinato Ms.Aarthi SuriyaDepartment:EEE				

OBJECTIVES The students will learn about the various Applications Programs (Aps) running in an Energy Management Systems (EMS) and their execution through SCADA.

COURSE OUTCOMES (COs)		
CO1	R	To remember an energy management systems, network analysis and SCADA.
CO2	U	To understand the power system automation, architecture and application of SCADA.
CO3	A	To apply the SCADA controlling system an electric power generation, transmission, distribution and also in real time.
CO4	An	To analyze an interpret software and hardware assembly in energy control centers.
CO5	E	To evaluate an implementation of power system automation and protection.
CO6	C	To design system for industrial applicationsSCADA

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO2
2	CO1			2		2			2			2		2	2
	CO2			2		2			2			2		2	2
	CO3			2		2			2			2	1	2	2
	CO4			2		2			2			2		2	2
	CO5			2		2			2			2	2	2	2
	CO6			3		3			3			3		3	3
3	Category	**PROGRAM ELECTIVE**(PE)													
4	Approval														

SYLLABUS

UNIT I EMS 9 Hours

Introduction to EMS, Objectives, Evolution of EMS, Evolution of SCADA, Function and Benefits of EMS, EMS Architecture, Practical EMS, Working of EMS, Power System Security: Introduction, Static Security Assessment, Operating states of Power System. Real Time or Online Application: Control Function, Protection Function, Operating States of Power System.

UNIT II Network Analysis Function of EMS 9 Hours

Real Time Function, Extended Real Time Function, State Estimation: Introduction, Conventional State Estimation, Linear state estimation. Economic Dispatch and Optimal Power Flow: Introduction, Economic Dispatch, Generation Model, Economic Dispatch Problem, Optimal Power Flow problem Formulation.

UNIT III SCADA 8 Hours

Introduction to SCADA, Evolution of SCADA, Benefits of SCADA, Function of SCADA, SCADA in Process control, SCADA Application, Usage of SCADA, Real-Time Monitoring and Control using SCADA, Data Acquisition, Data Communication, Data Presentation, Control.

UNIT IV SCADA Hardwar 8 Hours

Introduction, SCADA hardware Functions, Remote Terminal Units, SCADA RTU, Basic Functions, RTU Standards, Difference Between RTU and PLC, Features of SCADA. SCADA Software and Protocols: Introduction to ISO Model, DNP3 Model, Important Features of DNP3, IEC60870 PROTOCOL, HDLC, Modbus Protocol.

UNITV Power System Automation 8 Hours

Benefits of Power System Automation, Power System Automation, Architecture For Power System Automation, Classification of Power system Automation, Implementation of Power System Automation and Protection Using SCADA, SCADA Based Model for Automation and Digital Protection.

Text/Reference Books

1. Energy Management Systems", Handschin, E. Springer Verlag, 1990.
2. Real Time Control of Electric Power Systems", Handschin, E Elsevier, 1972.
3. Electric Power Substation Engineering", John D Mc Donald, CRC press, 2001.
4. Power Generation Operation and Control", Wood, A. J and Wallenberg, B. F, 2nd Edition John Wiley and Sons, 2003.

5. Control and Automation of Electric Power Distribution Systems, Green, J. N, Wilson, R
6. Energy Management Handbook, Turner, W. C 5th Edition, Taylor and Francis

U18PEEE34	**BIO-MEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Measurements and instruments				
	Course Coordinator: Mr.K.Dwarakesh Department: EEE				

OBJECTIVES

Discuss the internal circuitry of medical instruments and its maintenance.

COURSE OUTCOMES (COs)		
CO1	R	To remember physiology and anatomy of human system
CO2	U	To understand the technical concepts and operation of medical instrumentation
CO3	A	To apply and render a broad and modern account of biomedical instruments.
CO4	An	To analyze introductory idea about human physiology system which is very important with respect to design consideration
CO5	E	To evaluate an implementation of automation and protection system
CO6	C	To Test Biomedical application instruments

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PS O2
2	CO1		1	1					1		1	2		1	2
	CO2		1	1					1		1	2		1	2
	CO3		1	1					1		1	2	2	1	2
	CO4		1	1					1		1	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2		3	3
3	Category	**PROGRAM ELECTIVE COURSE (PE)**													
4	Approval														

SYLLABUS

UNIT I PHYSIOLOGY AND TRANSDUCERS 9

Electrophysiology: cell and its functions- Neuron-Axon-Synapse-Action Potential - Propagation of electrical impulses along the axon-Sodium sump-Salutatory condition-Electrophysiology and Cardiopulmonary systems- Respiration and nervous system and peripheral nervous system

UNIT II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9

Sensors and recorders: psychological transducer-general consideration for electronic recording systems- basic recording systems-pre amplifiers-direct writing recorders- UV recorders-electrostatic recorders-instrumentation tape recorders

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENTS 9

Modem imaging systems: X- ray machines and computed Tomography-magnetic resonance imaging systems--ultrasonic imaging systems-medical thermography-electron microscope

UNIT IV MEDICAL IMAGING AND PMS 9

Diagnostic equipment's: electrocardiograph-electroencephalograph-electromyography-blood flow meters-blood gas analyzers-computer applications in medical field- ultrasonic equipment's-bio telemetry-transmission of physiological data

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Therapeutic equipment's: pace makers- defibrillators-dialyzers-surgical diathermy machines-later applications-physiotherapy and electrotherapy equipment's

TEXT BOOKS

1. Arumugam M. 'BioMedical Instrumentation ', Anumdhaa Agencies ,1992
2. Gedders L.A. and Baker L.E. ' principles of Applied Bio- Medical instrumentation', john Wiley, 1989.

REFERENCES

1. Bertill Jacobson and john G. Webster 'Medicaland clinical Engineering' Prentice HallIndia , 1977
2. Gedders L.A and Baker L.E 'principles of applied Bio- medical instrumentation', John Wiley-Interscience, 3rd Edition, 1989.

PROGRAM ELECTIVE – 4

18PECBEE41	**Power Quality**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System I&II				
	Course Coordinator: Dr.V.Jayalakshmi Department:EEE				

COURSE OUTCOMES (COs)		
CO1	R	To remember the significance of power quality and powerfrequency.
CO2	U	To understandaboutthe load compensation methods.
CO3	A	To apply DSTATCOMin load compensation.
CO4	An	To analyze an effect of harmonics in power system
CO5	E	To evaluate the power quality and overvoltage problems.
CO6	C	Realization and control of DSTATCOM – DSTATCOM and Compensators

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO 2
2	CO1	3	1	1		2	2	3	3	3	3	3	3	1	2
	CO2	3	1	1										1	2
	CO3	2	1	2		2	2	1	2	2	2		2	1	2

	CO4	2	1	2						1	1	1		1	2
	CO5	1	1	2			2	2	2		2		3	1	2
	CO6	3	3	2			2	2	2		2			3	3
3	Category	**Program Elective Course (PE)**													
4	Approval														

OBJECTIVES

To understand the various power Quality Phenomenon, their origin and mitigation methods.
Understand the effects of various power quality phenomenon in various equipment.

SYLLABUS

UNIT I Introduction 9 Hours

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II Analysis of Single Phase And Three Phase System 9 Hours

Single phase linear and nonlinear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying nonlinear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III Conventional Load Compensation Methods 9 Hours

Principle of load compensation and voltage regulation – classical load balancing problem: open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured.

UNIT IV Load Compensation Using DSTATCOM 9 Hours

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

UNIT V Series Compensation Of Power Distribution System 9 Hours

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

TEXT/REFERENCE BOOKS

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition)
3. Power Quality - R.C. Duggan
4. Power System Harmonics –A.J. Arrillga
5. Power Electronic Converter Harmonics –Derek A. Paice

U18PEEE42	SOLID STATE RELAYS	L	T	P	C
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Power Electronics				
	Course Coordinator: Ms.S.Sherine Department:EEE				

OBJECTIVES

- To educate the basic concepts and new developments in solid state relays and power system protection

COURSE OUTCOMES (COs) Students will be able to		
CO1	R	To remember thedifferentprotective equipment's, power relays, etc.…
CO2	U	To understand the different applications of the relays, circuit breakers, grounding for different elements of power system.
CO3	A	To apply the various types of relay testing in power system protection.
CO4	An	To analyze a microprocessor based relays.
CO5	E	To evaluate the inverse time characteristics.
CO6	C	To design Microprocessor Based Relays

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2		1	2
	CO4		1	1					1		3	2		1	2
	CO5		1	1					1		2	2	1	1	2
	CO6		2	2					2		2	2		3	3
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I INTRODUCTION OF RELAYS 9

Comparators: phase and amplitude comparators-types-Direct and integrating rectifier bridge, circulating current, opposed voltage coincident type phase comparator-Direct or block spike phase comparator, phase splitting technique, integrating type phase comparator with transistor AND gate, hybrid comparator with transistor AND gate. Hybrid comparator- Hall effect type and magneto resistivity type, vector product type - zener diode phase comparators-Multi input-Three input coincidence comparators

UNIT II RELAY CIRCUIT 9

Static relay circuit (using analog and digital ic's) for over current, inverse time characteristics, differential relay.

UNIT III RELAY CIRCUIT 9

Static relay circuits fort generator loss of field, under frequency, distance relay, impedance, reactance, reverse power relays.

UNIT IV TRANSIENT BEHAVIOR OF RELAYS 9

Static relay circuits for carrier current protection-steady state and transient behavior of static relay-testing and maintenance - tripping circuits using thyristors.

UNIT V MICROPROCESSOR BASED RELAYS 9

Microprocessor based relays: hardware and software for the measurement of voltage, current, frequency, phase angle-microprocessor implementation of over current relays-inverse time characteristics-impedance relay-directional relay-mho relay.

TEXT BOOKS

1. Badri Ram, D. N. Vishwakarma 'power system protection and switchgear',22nd Edition, Tata Mcgraw Hill, 2001.
2. Rao, T.S.M. Power System Protection And Switch Gear, 2nd Edition, Wiley Eastern Ltd,1979.

REFERECE BOOKS

1. Van. C.Wamngton. 'Protective Relays- their theory and practice', 2nd Edition, Chapman and hall
2. Russel c. Mason, "The art and science of protective relays" 1st Edition. John Wiley and Sons Ltd
3. www.electromagneticrelays.in

U18PEEE43	**RENEWABLE ENERGY SOURCES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 43	3	0	0	3
	Prerequisite – Basic Electrical & Electronics Engineering				
	Course Coordinator: Dr. S.Prakash Department:EEE				

OBJECTIVES

To create awareness among the students about the different types of non-conventional energy resources and emphasize its importance

COURSE OUTCOMES (COs) After completion of the course the student will be able to		
CO1	R	Remember about renewable energy sources.
CO2	U	Able to understand how renewable energy can be used to help reduce greenhouse gases.
CO3	A	Apply ideas to perform case studies on renewable energy systems.
CO4	An	To analyze about the various energy generation technologies.
CO5	E	Criticize wind and solar systems
CO6	C	To design solar energy applications water heaters, air heaters, solar cooking, solar drying and power generation-tower concept (solar plant)-solar pump

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	h	i	j	k	l	PSO 1	PSO 2
2	CO1		1	1					1		3	2		1	2
	CO2		1	1					1		3	2		1	2
	CO3		1	1					1		3	2	M	1	2
	CO4		1	1					1		3	2		1	2
	CO5		1	1					1		3	2	1	1	2
	CO6		1	1					1		3	2		1	2
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

UNIT I INTRODUCTION ABOUT ENERGY RESOURCES 9

General primary and commercial energy resources- study of availability-energy consumption pattern and growth rath in India- non –commercial energy sources –availability, economics and efficiency

UNIT II SOLAR ENERGY AND APPLICATIONS OF SOLAR ENERGY 9

Solar energy and application; solar radiation-principles of solar energy collections- types of collectors-characteristics and principles of different types of collectors- their efficiencies-solar energy applications water heaters, air heaters, solar cooking, solar drying and power generation-tower concept (solar plant)-solar pump

UNIT III WIND ENERGY 9

Wind energy: energy from wind-general theory of wind mills - types of wind mills-performance of wind machines-wind power – efficiency.

UNIT IV TIDAL AND GEOTHERMAL ENERGY 9

Tidal Energy from tides and waves- working principles of tidal plants-tidal power generations –geothermal energy-principle of working of geothermal power plants

UNIT V BIOMASS ENERGY 9

Bio energy: energy from bio mass-biogas plants-various types-industrial wastes-municipal wastes-burning plants-energy from the agricultural wastes- applications

TEXT BOOKS

1. Rai.G.D, "Non-conventional resources of energy", Khanna publishers, Fourthedition, 2010.
2. Khan.B.H,"Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.

REFERENCE BOOKS

1. S.P.Sukhatme,' Solar Energy,(principles of thermal collection and storage), Tata McGraw-Hill Publishers, Fourth print-February 1989
2. Ronald Shaw,'Wave Energy – (A Design Challenge)',Ellis Horwood Limited publishers, first edition- 1982
3. http://nptel.ac.in/courses/113104058/mme_pdf/Lecture1.pdf

U18PEEE44	**Industrial Electrical Systems & Automation**	**L**	**T**	**P**	**C**
	Total Contact Hours – 42	3	0	0	3
	Prerequisite –Power system II and Measurement& Instrumentation				
	Course Coordinator: Ms Rathika. RDepartment:EEE				

OBJECTIVES At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and selectthe proper size of various electrical system components.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the principles of batteries.
CO2	U	Understand the construction of batteries.
CO3	A	Apply the knowledge of Electrical and Electronics engineering concepts in Automotive controls.
CO4	An	Analyzing Electronic Fuel Injection, starting, Ignition Systems and Sensors.
CO5	E	Identify, demonstrate and compare the various components and systems of Auto electrical stems.
CO6	C	To explore practically about the components present in an Automotive electrical and Electronics system.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO2
2	CO1			2					1	2	2	2		2	
	CO2			2					1	2	2	2	M	2	
	CO3			2					1	2	2	2		2	
	CO4			2					1	2	2	2		2	
	CO5			2					1	2	2	2		2	
	CO6			2		2			2	2	2	2	1	1	1
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I Electrical System Components 8 Hours

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II Residential and Commercial Electrical Systems 8 Hours

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III Illumination Systems 6 Hours

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV Industrial Electrical Systems I 8 Hours

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing

design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V Industrial Electrical Systems II 6 Hours

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

UNIT VI Industrial Electrical System Automation 6 Hours

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

- S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers, 2008.
- K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
- S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co., 1997.
- Web site for IS Standards.
- H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

PROGRAM ELECTIVE – 5

U18PEEE51	**Power System Dynamics and Control**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System II				
	Course Coordinator: Dr.V.Jayalakshmi Department:EEE				

OBJECTIVES

To gain fundamental knowledge of the power system mathematical modelling and predict power system dynamic behavior during and after disturbances.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	To explain the methods to enhance the small signal stability of the power system.
CO2	U	Understand the concept of stability problems in power system.
CO3	A	Apply the concepts of modeling and simulating the dynamic phenomena of power systems, Interpret results of system stability studies
CO4	An	Analysis of Linear Dynamical System& issues in modeling
CO5	E	Evaluating the system stability and controllers.
CO6	C	To develop dynamic modeling of a synchronous machine&and Associated Controllers

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2

2	CO1	1	1			1		3	2	2	2	1	2	1	2
	CO2		1			1		3	2	2	2	1	2	1	2
	CO3		1			1		3	2	2	2	1	2	1	2
	CO4	1	1			1		3	2	2	2	1	2	1	2
	CO5	1	1			1		3	2	2	2	1	2	1	2
	CO6														
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT I Introduction to Power System Operations 3 Hours

Introduction to power system stability.Power System Operations and Control.Stability problems in Power System.Impact on Power System Operations and control.

UNIT II Analysis of Linear Dynamical System and Numerical Methods 5 Hours

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability.Modal Analysis of Linear System.Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

UNIT III Modeling of Synchronous Machines and Associated Controllers 12 Hours

Modeling of synchronous machine: Physical Characteristics.Rotor position dependent model.D-Q Transformation.Model with Standard Parameters.Steady State Analysis of Synchronous Machine.Short Circuit Transient Analysis of a Synchronous Machine.Synchronization of Synchronous Machine to an Infinite Bus.Modeling of Excitation and Prime Mover Systems.Physical Characteristics and Models.Excitation System Control.Automatic Voltage Regulator.Prime Mover Control Systems. Speed Governors.

UNIT IV Modeling of other Power System Components 10 Hours

Modeling of Transmission Lines and Loads.Transmission Line Physical Characteristics.Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

UNIT V Stability Analysis 11Hours

Angular stability analysis in Single Machine Infinite Bus System.Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor Droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

UNIT VI Enhancing System Stability 4 Hours

Planning Measures.Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control.Emergency Control.

Text/Reference Books

1.K.R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002.
2.P. Kundur, “Power System Stability and Control”, McGraw Hill, 1995.

3.P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

U18PEEE52	**Power Converter Analysis and Design**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite – Analog Electronics Circuits & Digital Electronics				
	Course Coordinator: Mrs.S.SherineDepartment:EEE				

OBJECTIVES

To gain the knowledge on power converter analysis and design

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Learning power electronics system simulation and control methods
CO2	U	Understanding operation and analysis of switched mode DCDC converters and their signing.
CO3	A	Apply suitable controllers to converters and inverters
CO4	An	Skill of analyzing power electronic devices
CO5	E	Fitness in mitigating converter harmonics.
CO6	C	Developing Ripple free system for renewable energy sources.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	G	H	i	j	k	l	PSO 1	PSO2
2	CO1		2	2								2	2	2	1
	CO2		2	2								2	2	2	1
	CO3		2	2								2	2	2	1
	CO4		2	2								2	2	2	2
	CO5		2	2								2	2	2	2
	CO6		2	2								2	2	2	2
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT 1 SNUBBER AND DRIVE CIRCUITS

Design considerations: Snubber circuit for power switching devices Thermal design: temperature control, Heat sink Gate Trigger Circuits for Thyristors Base drive circuits for BJT and Gate drive circuit for MOSFET Practical converter design considerations

UNIT II ANALYSIS AND DESIGN OF DC-DC CONVERTERS

Classification of DC-DC converters. Analysis of buck, boost in continuous and discontinuous operations Analysis of buck- boost, Cuk and Sepic converters in continuous and discontinuous operations Analysis of Forward, Fly back ,half bridge and full bridge isolated converters Design of isolated and non-isolated DC-DC converters Estimating the Output Voltage Ripple in Converters Containing Two-Pole Low-Pass Filters, Input and output filter design

UNIT III ANALYSIS AND DESIGN OF MULTILEVEL INVERTERS

Multilevel concept, Classification of multilevel inverters Diode clamped, improved diode Clamped, Flying capacitors multilevel inverter analysis. Design of multilevel inverters Influence of PWM techniques on switching loss, design of PWM for low inverter loss

UNIT 1V DESIGN OF CONVERTER CONTROL

Control and analysis of voltage mode and current modes. Review of different controllers used in power electronic converters Introduction to controller design Sliding Mode Control of Power Converters , Fuzzy Logic Control of Power Converters

UNIT V RESONANT CONVERTERS

Principles of resonant converters, Classical series resonant and parallel resonant converters, Quasi-Resonant Converters, Multi resonant Converters, Zero-VoltageTransition (ZVT) Converters, Zero-voltage and Zero-current switching, Resonant converter design techniques based on frequency response

Text

1. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics Converters, Applications, and Design”, Wiley India PvtLtd,Third Edition, 2011.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition,2011.

References

1. Umanand.L ,"Power Electronics Essentials and Applications", John Wiley & Sons, First Edition 2009.
2. Erickson R. W. and Maksimovic .D, “Fundamentals of Power Electronics”, Kluwer Academic Publishers,Second Edition, Reprint 2012.
3. http://www.peg.ee.iisc.ernet.in/people/faculty/vram/smpc/smpcbook.pdf-Course Material on Switched Mode Power Conversion, V. Ramanarayanan 2008.
4. M.H. Rashid “Power Electronics Handbook”, ISBN 978-0-12-382036-5, Elsevier Third Edition, 2011

U18PEEE53	**ELECTRIC POWER DISTRIBUTION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System I				
	Course Coordinator: Dr.S.P.VijayaraghavanDepartment:EEE				

OBJECTIVES

Student will be able to:

1. Learning about power distribution system
2. Learning of SCADA System
3. Understanding Distribution Automation

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the process power distribution system
CO2	U	Understand the concept of Distribution Management System, Optimum Switching Device Placement , Control & Communication Systems
CO3	A	To apply the concept of Distribution Management System, Control & Communication Systems using SCADA system
CO4	An	Analyze the Distribution automation and its application in practice&Coordination of Protective Devices
CO5	E	Differentiate the types of loads and their characteristics
CO6	C	Design a radial and loop type distribution feeders.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO2
2	CO1	1		1		1		2	1						1
	CO2			1		1			1						1
	CO3	1				1	2		1			1		1	1
	CO4		1			1		2	1			1	2		1
	CO5					1			1			1			1
	CO6	1					2					1	1	3	3
3	Category	PROGRAM ELECTIVE(PE)													
4	Approval														

SYLLABUS

UNIT I Load Forecasting&Power Management 8 Hours

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

UNIT II Distribution Automation 8 Hours

Advantages of Distribution Management System (D.M.S.) Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints Power Factor Correction.

UNIT III Control & Communication system 8 Hours

Interconnection of Distribution, Control& Communication Systems, Remote Metering, Automatic Meter Reading and its implementation.

UNIT IV SCADA 8 Hours

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

UNIT V Switching operation and Types 7 Hours

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.

UNIT VI Automation Distribution Systems 6 Hours

Maintenance of Automated Distribution Systems Difficulties in Implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

REFERENCES

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press
4. JamesMomoh, "Electric Power Distribution, automation, protection & control", CRC Press.

U18PEEE54	INSTRUMENTATION AND CONTROL IN POW PLANT INDUSTRIES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Measurement & Instrumentationand Control System				
	Course Coordinator: Ms.Aarthi SuriyaDepartment:EEE				

OBJECTIVES

We can know about the various methods of power generation and its control methods.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember different power generation process.
CO2	U	Understand the important parameters that has to be monitored and controlled
CO3	A	To get an detailed knowledge about Nuclear Power Plant Instrumentation and apply it in control loops
CO4	An	To be familiar about the various parameters that has to be analyzed and measured analytically.
CO5	E	Evaluate the working of boilers
CO6	C	Design control loops for Boiler

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	PSO1	PSO2
2	CO1	3	3	3	3	3		3	3	3	3	3	3	2
	CO2	3			2	2	2	3	3				2	2
	CO3	3	2	1									2	2
	CO4		1	1	1								2	2
	CO5	1	1	1					1		1		2	2
	CO6	1	2	1	1	2		1	1	1	2	2	3	2
3	Category	PROGRAM ELECTIVE (PE)												
4	Approval													

SYLLABUS

UNIT I Overview of Power Generation 9 Hours

Brief survey of methods of power generation-Wind, Solar, Tidal, Geothermal, MHD, Fuel cells, Biomass-Conventional energy resources-Hydro, Nuclear, Gas, Thermal-Comparison of various conventional power plants-Importance of Instrumentation and control in power generation-P&I diagrams-P&I diagram of boiler-co-generation

.

UNIT II Turbine Monitoring and Control 9 Hours

Electrical parameters-Current, Voltage, Power, Energy, Frequency, Power factor etc-Non-electrical parameters-Flow of feed water, fuel, air and steam with correction factor for temperature and pressure-Speed, vibration, shell temperature monitoring and control-Steam pressure control-Lubricant oil temperature control- cooling system.

UNITIII Analytical Measurement 9 Hours

Oxygen measurement in flue gas-CO2 in flue gas-Combustibles analyzers-Infrared flue gas analyzers-Smoke detector-Dust monitor-Closed Circuit Television-Fuel analyzers-Pollution monitoring instruments

UNITIV Control Loops In Boilers 9 Hours

Combustion control-air-fuel ratio control-furnace draft control-drum level control- main steam and reheat steam temperature control-super heater control- attemperator- deaerator control-Distributed Control System in power plant interlocks in boiler operation. 188 IC-2013 SRM(E&T)

UNIT V Nuclear Power Plant Instrumentation 9 Hours

Introduction-Nuclear physics-Classification of nuclear reactors-Basic reactor systems-P&I diagram of Nuclear power plant-Radiation detection instruments- nuclear reactor control systems and allied instrumentation.

TEXT BOOKS

1. P. K. Nag, "Power Plant Engineering" 2nd Edition, Tata McGraw-Hill Education, 2002
2. Sam G. Dukelow, "The control of boilers" 2nd Edition, Research Triangle Park, 1991.

REFERENCES

1. R.K.Jain, "Mechanical and Industrial Measurements", 10th Edition, Khanna Publishers, New Delhi,1995.
2. Bela G Liptak, "Instrumentation in the processing industries"1st edition, Chilton Book Co, Chilton Book Co; 1973.
3. https://app.knovel.com/web/toc.v/cid:kpPCITCBH4.

PROGRAM ELECTIVE – 6

U18PEEE61	**Flexible AC Transmission Systems**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Power System II				
	Course Coordinator: Dr.V.Jayalakshmi Department:EEE				

OBJECTIVES

This course introduces the application of a variety of high power-electronic controllers for active and reactive power in transmission lines. Students are exposed to the basics, modeling aspects, control and scope for different types of FACTS controllers.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Rememberthe basic concepts ofelectrical power transmission lines.
CO2	U	Understand and analyze the concept of FACTS
CO3	A	Apply various FACTS controllers according to compensation schemes.
CO4	An	Analyse the various types of compensation Techniques(VAR,TCSC,SVC , STATCOM,DVR)
CO5	E	Evaluation of Power flow, Stability analysis of various systems
CO6	C	Modelling of FACTS Controllers for Stability analysis.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1		2	3		3	3			2		3	3	2	2
	CO2		2	2		3	2			3		2		2	2
	CO3		2	2		2	2			2				2	2
	CO4		2	2		2	2			2		2		2	2

	CO5		2	2		1	3			3		2		2	2
	CO6		3	2		3	3			2				3	3
3	Category	Program Elective (PE)													
4	Approval														

Syllabus

UNIT I Introduction 9 Hours

Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

UNIT II Static VAR Compensator (SVC) and Applications 9 Hours

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

UNIT III Thyristor Controlled Series Capacitor (TCSC) and Applications 9 Hours

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV Voltage Source Converter Based FACTS Controllers 9 Hours

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability - prevention of voltage instability. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load flow and transient stability studies.

UNIT V Co-Ordination of FACTS Controllers 9 Hours

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

Text Books

1. R.MohanMathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical TransmissionSystems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible ACTransmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.

References

1. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers, 2004.

U18PEEE62	**Power electronics application to renewable energy system**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite – Power Electronics				
	Course Coordinator: Dr.Prakash.S Department:EEE				

OBJECTIVES To learn about the impacts of renewable energy generation on environment

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember various types of renewable energy sources& drives
CO2	U	Understand the concepts of PV,Wind and Hybrid energy sources
CO3	A	Applying appropriate maximum power point tracking techniques.
CO4	An	To analyze the performance of IG, PMSG, SCIG and DFIG.
CO5	E	Evaluating various operating modes of wind electrical generators and solar energy Systems.
CO6	C	To design different power converters namely AC to DC, DC to DC and Ac to AC Converters for renewable energy sources.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	c	d	e	f	g	H	i	j	k	l	PSO 1	PSO2
2	CO1		2	2								2		2	1
	CO2		2	2								2		2	1
	CO3		2	2								3	2	2	2
	CO4		2	2								2		2	2
	CO5		2	3								2		2	2
	CO6		3	2								2		3	3
3	Category	**PROGRAM ELECTIVE (PE)**													
4	Approval														

SYLLABUS

UNIT-I INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost- GHG Emission) – Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Review of reference theory fundamentals – Principle of Operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT-III POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system – Principle of Operation: Line Commutated Converters (inversion – mode) –Boost and Buck- Boost Converters- Selection of Inverter, battery sizing, array sizing.

Wind: Three phase AC Voltage Controllers- AC-DC-AC Converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters- Matrix Converters.

UNIT-IV ANALYSIS OF WIND AND PV SYSTEMS **9**

Standalone operation of fixed and variable speed wind energy conversion systems and solar system- Grid Connection Issues- Grid integrated PMSG and SCIG Based WECS- Grid integrated solar System.

UNIT-V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems- Range and type of Hybrid Systems- Case studies of Wind- PV- Maximum Power point Tracking(MPPT).

Total Periods: 45

REFERENCES

1. Rashid.M.H."Power Electronics Hand book", Academic press,2001.
2. Rai.G.D."Non conventional energy sources", Khanna Publishers,1993.
3. Rai.G.D."Solar energy Utilization "Khanna Publishers,1993.
4. Gray.L..Johnson. "Wind Energy System". Prentice Hall linc,1995.
5. Non-Conventional Energy Sources B.H.Khan Tata McGraw-hill Publishing company, New Delhi.

U18PEEE63	**WIND AND SOLAR ENERGY SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 39	3	0	0	3
	Prerequisite –Electrical Machines-I& II				
	Course Coordinator: Dr.K.Sakthivel Department:EEE				

OBJECTIVES

At the end of this course, students will demonstrate the ability to understand the energy scenario and the consequent growth of the power generation from renewable energy sources.

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remember the design specifications wind and solar system.
CO2	U	Understand the basic renewable energy sources & systems.
CO3	A	Apply engineering techniques to build solar, wind energy systems.
CO4	An	Analyze and evaluate the implication of renewable energy.
CO5	E	Evaluating the concepts in solving numerical problems pertaining to solar radiation geometry and wind energy systems.
CO6	C	Demonstrate self -learning capability to design & establish renewable energy systems.

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low															
1	COs/Pos	a	b	C	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
2	CO1	2	1	1		2	2	3	3	3	3	3	3	1	2
	CO2	2	1	1										1	2
	CO3	2	1	2		2	2	1	2	2	2		2	1	2
	CO4	2	1	2						1	1	1		1	2
	CO5	2	1	2			2	2	2		2		3	1	2
	CO6	2	1	1		2	2	3	3	3	3	3	3	1	2
3	Category	**PROGRAMELECTIVE** (PE)													
4	Approval														

SYLLABUS

UNIT I Physics of Wind Power 5 Hours

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution function

UNIT II Wind generator topologies 12 Hours

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

UNIT III the Solar Resource 3 Hours

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

UNIT IV Solar photovoltaic 8 Hours

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV UNIT, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT V Network Integration Issues 8 Hours

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

UNIT VI Solar thermal power generation 3 Hours

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text Books

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

References Books

1. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
2. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa ublications, 2004.
3. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

U18PEEE64	**ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite- Measurement & Instrumentation				
	Course Coordinator: Mr.K.DwarakeshDepartment:EEE				

OBJECTIVES

To provide comprehensive knowledge of robotics in the design, analysis and control point of

COURSE OUTCOMES (COs) At the end of this course, students will demonstrate the ability to		
CO1	R	Remembering the perception of actuators,sensors&transducers
CO2	U	Understand the dynamics ,control of electric drives and Robotic programming
CO3	A	Select the appropriate sensor, actuators& grippers with the robotic systems.
CO4	An	Analyse the singularity issues associated with the operation of robotic systems
CO5	E	Evaluation of algebraic tools for the description of motion.
CO6	C	To develop the ability to and design the motion for articulated systems View

Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low														
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	PSO1	PSO2
2	CO1	2	1	1		2	2	3	3	3	3	3	3	1
	CO2	2	1	1										1
	CO3	2	1	2		2	2	1	2	2	2		2	1
	CO4	2	1	2						1	1	1		1
	CO5	2	1	2			2	2	2		2		3	1
	CO6	2	1	2			2	2	2		2		2	3
3	Category	**PROGRAM ELECTIVE (PE)**												
4	Approval													

Syllabus

UNIT I Basic concepts 9 Hours

Robotics – basic components – classification - performance characteristics- drives and control systems – electric , hydraulic and pneumatic actuators – control loops using current amplifiers and voltage amplifiers**.**

UNITII Sensors and Transducers 9 Hours

Sensors and vision systems; Transducers and sensors – tactile sensors –Proximity and range sensors –Acoustics sensors- visition systems – image Processing and analysis – image data reduction – segmentation feature

UNIT III Robotic Programming and Gripper 9 Hours

End effectors –type –mechanical gripper –vacuum cup- magnetic grippers – robot to end effectors interface –software for industrial robots – positive stop program-Point to point program and continuous path program.

UNIT IV Kinematics and path planning 9 Hours

Robot motion analysis and control manipulation kinematics – homogeneous Transformation

and robot dynamics configuration of a robot controller.

UNIT V Industrial Robot 9 Hours

Industrial robots –Robots for welding ,painting and assembling –remote Controlled robots for nuclear ,thermal and chemical plants –industrial Automation – typical examples of automated industries .

Text Books

1. MikellPGroover, "Industrial robotics : technology, programming, and applications" McGraw Hill New Delhi, 1996.
2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998.

References

1. Deb.S.R, "Robotics technology and flexible Automation", John Wiley1992.
2. Asfahl. C.R, "Robots and manufacturing Automation", John Wiley, USA ,1992.
3. https://www.youtube.com/watch?v=DaWMvEY3Qgc&list=PLED9EB384E656C007
4. http://www.nptel.ac.in/downloads/112101098/

OPEN ELECTIVES

U18OEEE01	**GREEN TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Course Coordinator: Dr.S.Prakash Department:EEE				
OBJECTIVES Green Technologies is a highly interdisciplinary degree program that emphasizes green systems and environment, energy technology and efficiency, and sustainability and society					

SYLLABUS

UNIT- I INTRODUCTION

Green Technology – definition- Importance – Historical evolution – advantages and disadvantages of green technologies-factors affecting green technologies- Role of Industry, Government and Institutions – Industrial Ecology – role of industrial ecology in green technology.

UNIT- II CLEANER PRODUCTION (CP)

Definition – Importance – Historical evolution – Principles of Cleaner Production–Benefits– Promotion – Barriers – Role of Industry, Government and Institutions – clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste, case studies.

UNIT- III POLLUTION PREVENTION AND CLEANER PRODUCTION AWARENESS PLAN

Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment – Elements of LCA – Life Cycle Costing – Eco Labelling.

UNIT -IV AVAILABILITY AND NEED OF CONVENTIONAL ENERGY RESOURCES

Major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices, their principles, working and application.

UNIT- V GREEN FUELS

Definition-benefits and challenges – comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts- public policies and market-driven initiatives. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context; tidal and geothermal energy.

REFERENCES

- 'Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
- 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.
- 'Cleaner Production Audit' by Prasad Modak, C.Visvanathan and MandarParasnis (1995), Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok
- 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
- 'Energy, The Solar Hydrogen Alternative' by Bokris J.O.
- 'Non-conventional Energy Sources' by Rai G.D.
- 'Solar Energy' by Sukhatme S.P.
- 'Waste Energy Utilization Technology' by Kiang Y. H.

U18OEEE02	**ELECTRICAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Course Coordinator: Dr.T.R.Rangaswamy Department:EEE				

OBJECTIVES

The objective of the course is to introduce IE rules and its significance, electrical safety in residen commercial and industrial installations. It also helps the students to know about the electrical safet during installation, testing and commissioning, operation and maintenance. Besides, it enables the stud to know more about the quality management**.**

SYLLABUS

UNIT I REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE 9

Objective and scope– ground clearances and section clearances– standards on electrical safety safe limits of current, voltage–earthing of system neutral –Rules regarding first aid and firefighting facility.

UNIT II

ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS 9

Wiring and fitting–Domestic appliances– water tap giving shock–shock from wet wall–fan Firing shock–multi-storied building–Temporary installations–Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT III

SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE 9

Preliminary preparations–safe sequence–risk of plant and equipment–safety documentation–

field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safe guards for operators– safety.\

UNIT IV
ELECTRICAL SAFETY IN HAZARDOUS AREAS 9
Hazardous zones–class0,1 and 2– spark, flash overs and corona discharge and functional requirements– Specifications of electrical plants, equipments for hazardous locations– Classification of equipment enclosure for various hazardous gases and vapours– classification of equipment/enclosure for hazardous locations.

UNIT V PROTECTION SYSTEMS 9
Fuse – circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections-means of cutting of power-overload and short circuit protection-no load protection-earth fault protection-earthing standards FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances and tools.

Total No. of Periods: 45

References

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety EnggAnd safety management", Khanna Publishers. NewDelhi, 1988. PondicherryUniversity: Syllabus for B.Tech(EEE)FourthYear SYLLABUS.
2. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company,New Delhi, 1997.
3. Nagrath. I.J. and Kothari. D.P. "Power System Engineering", Tata McGrawHill Publishing company Ltd. New Delhi, 1998

U18OEEE03	**ENERGY CONSERVATION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Course Coordinator: Dr.S.P.Vijaraghavan Department:EEE				

OBJECTIVES
To analyze the pros and cons of
- Conventional energy conversion techniques
- Direct energy conversion systems
- Need and necessity of energy storage systems and their desirable characteristics
- Detail on thermodynamics and kinetics of fuel cells

SYLLABUS

UNIT I INTRODUCTION 8
Energy conversion – conventional techniques – reversible and irreversible cycles – Carnot, Stirling and Ericsson – Otto, Diesel, Dual, Lenoir, Atkinson, Brayton, rankine.

UNIT IIDIRECT CONVERSION OF THERMAL TO ELECTRICAL ENERGY8
Thermoelectric Converters – thermoelectric refrigerator – thermoelectric generator – Thermionic converters – Ferro electric converter – Nernst effect generator – thermo magnetic converter.

UNIT III CHEMICAL AND ELECTROMAGNETIC ENERGY TO ELECTRICAL ENERGY 9

Batteries – types – working – performance governing parameters – hydrogen energy – solar cells.

UNIT IV ENERGY STORAGE SYSTEMS 9

Introduction – storage of mechanical energy, electrical energy, chemical energy, thermal energy.

UNIT VFUEL CELLS11

Basics – working advantages and drawbacks – types – comparative analysis – thermodynamics and kinetics of fuel cell process – performance of fuel cell – applications.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Archie.W.Culp, Principles of Energy Conversion, McGraw-Hill Inc., 1991, Singapore
2. Kordesch. K, and Simader.G, Fuel Cell and Their Applications, Wiley-Vch, Germany 1996

REFERENCES

1. Kettari, M.A.Direct Energy Conversion, Addison-Wesley Pub. Co 1997
2. Hart A.B and Womack, G.J.Fuel Cells: Theory and Application, Prentice Hall, Newyork Ltd., London 1989

U18OEEE04	**PLC AND SCADA FOR INDUSTRIAL AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Course Coordinator: Dr.V.Jayalakshmi Department:EEE				

OBJECTIVES

This course introduces the student to practical methods of automatic control of machines, processes systems. Also the student will learn the PLC programming fundamentals and some knowledge in SCADA which are used in process automation industries.

SYLLABUS

UNIT I - INTRODUCTION TO AUTOMATION 9 hours

Architecture of industrial automation systems-Manufacturing plants and operations-Industrial control Systems- Process, Discrete manufacturing industries Fluid Power and Electrical Actuators- Piezoelectric Actuator-

UNIT II – PROGRAMMABLE LOGIC CONTROLLER BASICS 9 hours

Overview of PLC systems – parts of PLC –Input/output UNITs – power supplies and isolators – Fundamental PLC wiring diagram – relays – switches –transducers – sensors –seal-in circuits.

UNIT III – PROGRAMMING OF PLC 9 hours

Fundamentals of logic – Program scan – Relay logic – PLC programming languages – timers – counters – math instructions – data manipulation instructions – requirement of communication networks for PLC – connecting PLC to computer.

UNIT IV – SCADA **9 hours**

Definition – elements of SCADA system – history of SCADA – remote terminal unit (RTU) – discrete control – analog control – master terminal unit – (MTU) –operator interface.

UNIT V – DISTRIBUTED CONTROL SYSTEM **9 hours**

Evolution – Different architectures – local control unit – Operator Interface – Displays – Engineering Interface – DCS Applications in power plants – Iron plant –steel plant– Cement plant.

Text Books

1. "PLC and Industrial application", MadhuchhandanGupts and SamarjitSen Gupta, pernram international pub. (Indian) Pvt. Ltd., 2011.
2.Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books

1.1.GaryDunning,"Introduction to Programmable Logic Controllers", Thomson,2nd Edition.
2.John W Webb, Ronald A Reis,"Programmable Logic Controllers: Principles and Application", PHI Learning, Newdelhi, 5th Edition
3.Stuart A Boyer, "SCADA Supervisory Control and Data Acqusition", ISA, 4th Revised edition

CURRICULUM AND SYLLABUS (R2018)

CHOICE BASED FLEXIBLE CREDIT SYSTEM

(Applicable to the batches admitted from July, 2018)

B.Tech – AUTOMOBILE ENGINEERING

FULL TIME

SEMESTER I - VIII

SEMESTER I								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
3	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	0
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
9	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	35	15	1	19	20.5

*** Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics- II	4	3	1	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
11	18MCAB203	MC	Yoga	2	0	0	2	0
12	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	17	2	17	25.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

III SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18BSMA302	BS	Partial Differential Equations, Probability and Statistics	4	3	1	0	4
2	U18PCAU301	PC	Solid Mechanics	3	3	0	0	3
3	U18PCAU302	PC	Engineering Fluid Mechanics	3	3	0	0	3
4	U18PCAU303	PC	Thermodynamics and Thermal Engineering	3	3	0	0	3
5	U18PCAU304	PC	Materials Technology	3	3	0	0	3
6	U18PCAU305	PC	Automotive Petrol Engines	3	3	0	0	3
PRACTICAL								
7	U18PCAU3L1	PC	Automotive Parts and Assembly Drawing	2	0	0	2	1
8	U18PCAU3L2	PC	Fluid Mechanics and Strength of Materials Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	**27**	**18**	**1**	**8**	**21**

IV SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18BSMA401	BS	Numerical Methods	4	3	1	0	4
2	U18PCAU401	PC	Automotive Chassis	4	3	1	0	3
3	U18PCAU402	PC	Automotive Electrical Systems	3	3	0	0	3
4	U18PCAU403	PC	Design of Engine Components	4	3	1	0	4
5	U18PCAU404	PC	Automotive Diesel Engines	3	3	0	0	3
6	U18PCAU405	PC	Manufacturing Technology	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	0	0	2	0
	PRACTICAL							
8	U18PCAU4L1	PC	Automotive Electrical & Electronics Lab	2	0	0	2	1
9	U18PCAU4L2	PC	Manufacturing Technology Lab	2	0	0	2	1
10	U18PCAU4L3	PC	Automotive Engines and Chassis Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	**35**	**18**	**3**	**14**	**23**

V SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PCAU501	PC	Automotive Transmission	3	3	0	0	3
2	U18HSEN501	HS	Organizational Behavior	3	3	0	0	3
3	U18PCAU502	PC	Automotive Aerodynamics	3	3	0	0	3
4	U18PCAU503	PC	Electronic Engine Management System	3	3	0	0	3
5		PE	Professional Elective-I	3	3	0	0	3
6	U18PCAU504	PC	Design of Chassis Components	4	3	1	0	4
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
	PRACTICAL							
8	U18PCAU5L1	PC	Autotronics Lab	2	0	0	2	1
9	U18PCAU5L2	PC	Engine Testing Emission Measurement Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	**29**	**20**	**1**	**8**	**21**

VI SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18BSMA601	BS	Operation Research	3	2	1	0	3
2	U18PCAU601	PC	Electric & Hybrid Vehicle	3	3	0	0	3
		PE	Professional Elective-II					
3		PE	Professional Elective-III	3	3	0	0	3
4		PE	Professional Elective-IV	3	3	0	0	3
		OE	Open Elective-I	3	3	0	0	3
5	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
6	U18PCAU6L1	PC	Two & Three Wheelers Lab	2	0	0	2	1.5
7	U18PCAU6L2	PC	CAD/CAM Lab	2	0	0	2	1.5
			Soft Skill					1
8	U18EEAU6V1	EE	Industrial Training /Internship					1
ACTIVITY BASED COURSES								
9	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0

Total	**23**	**19**	**1**	**9**	**20**

VII SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1	U18PCAU701	PC	Vehicle Dynamics	4	3	1	0	4
2	U18PCAU702	PC	Vehicle Maintenance	3	3	0	0	3
3	U18PCAU602	PC	Vehicle Body Engineering	3	3	0	0	3
4		PE	Professional Elective-V	3	3	0	0	3
5		OE	Open Elective-II	3	3	0	0	3
PRACTICAL								
6	U18PCAU7L1	PC	Vehicle Dynamics Lab	2	0	0	2	1
7	U18PCAU7L2	PC	Vehicle Maintenance Lab	2	0	0	2	1
8	U18EEAU6P1	EE	Project-I	6	0	0	6	3
	ACTIVITY BASED COURSES							
9	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
10	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	**33**	**18**	**1**	**14**	**21**

VIII SEMESTER								
THEORY								
Sl.No.	**Sub. Code**	**Category**	**Subject Name**	**Contact Periods**	**L**	**T**	**P**	**C**
1		PE	Professional Elective-VI	3	3	0	0	3
		OE	Open Elective-III	3	3	0	0	3
2		OE	Open Elective-IV (MOOC Course)	3	2	0	0	2
PRACTICAL								
3	U18EEAU8P2	EE	Project-II	18	0	0	18	9
ACTIVITY BASED COURSES								
4	U18MCAB815	MC	`Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	**26**	**6**	**0**	**20**	**17**

OVERALL CREDITS: 169

LIST OF ELECTIVES

Code No.	Specialization	Course Title	L	T	P	C
Professional Elective-I (Semester V)						
U18PEAU011	Manufacturing	Manufacturing of Automotive Components	3	0	0	3
U18PEAU012	Engines	Automotive Pollution and Control	3	0	0	3
U18PEAU013	Vehicle Technology	Automotive Control Systems	3	0	0	3
U18PEAU014	Design	Product Design and Development	3	0	0	3
	Professional Elective-II (Semester VI)					
U18PEAU021	Manufacturing	Agile Manufacturing	3	0	0	3
U18PEAU022	Engines	Alternate Fuels and Energy Systems	3	0	0	3
U18PEAU023	Vehicle Technology	Special Type of Vehicles	3	0	0	3
U18PEAU024		Automotive Standards and Regulations	3	0	0	3
	Professional Elective-III (Semester VI)					
U18PEAU031	Manufacturing	Flexible Manufacturing Systems	3	0	0	3
U18PEAU032	Engines	Combustion Engineering	3	0	0	3
U18PEAU033	Vehicle Technology	Heating Ventilation and Air Conditioning	3	0	0	3
U18PEAU034	Design	Automotive Styling	3	0	0	3
	Professional Elective-IV (Semester VII)					
U18PEAU041	Auto Electronics	Artificial Intelligence	3	0	0	3
U18PEAU042	Engines	Fuels and Lubricants	3	0	0	3
U18PEAU043	Vehicle Technology	Two and Three Wheelers	3	0	0	3
U18PEAU044	Design	Automotive Instrumentation and Embedded System	3	0	0	3
Professional Elective-V (Semester VII)						
U18PEAU051	Auto Electronics	Robotics for Automobile Engineers	3	0	0	3
U18PEAU052	Engines	Simulation of IC Engines	3	0	0	3
U18PEAU053	Vehicle Technology	Tyre Technology	3	0	0	3
U18PEAU054	Design	Automotive Safety	3	0	0	3
Professional Elective-VI (Semester VIII)						
U18PEAU061	Management	Transport Management and Motor Industry	3	0	0	3
U18PEAU062	Engines	Noise Vibration and Harshness	3	0	0	3
U18PEAU063	Vehicle Technology	Chassis Control System	3	0	0	3
U18PEAU064	Vehicle Technology	Intelligent Vehicle Technology	3	0	0	3

OPEN ELECTIVES

COURSES OFFERED BY THE DEPT OF AUTO ENGG						
1	U18OEAU001	Electric and Hybrid Vehicles	3	0	0	3
2	U18OEAU002	Intelligent Transportation System	3	0	0	3
3	U18OEAU003	Vibration and Noise Control	3	0	0	3
4	U18OEAU004	Automotive Sensors and Applications	3	0	0	3

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences including Management Courses (HS)	3	3			3				9	5
2	Basic Sciences (BS)	10	15	4	4		3			36	21
3	Engineering Sciences (ES)	7.5	7.5							15	9
4	Professional Core (PC)			17	19	15	5	12		68	40
5	Professional Electives (PE)					3	6	6	3	18	10
6	Open Electives (OE)							3		3	1
7	Massive Online Open Course (MOOC)								2	2	1
8	Employability Enhancement Courses (EE)Project Work, Seminar, Internship, Term Paper, etc.				1		1	3	9	14	8
9	Mandatory Courses (MC)	0	0	0	0	0	0	0	0	0	0
	Total Credit	20.5	25.5	21	24	21	18	24	14	169	95%
	Total Contact Hour	35	36	27	35	29	23	33	26	244 Hours	

List of Courses under Humanities & Social Sciences including Management Courses (HS)

S. No	Course Code	Course Name	L	T	P	C
1	U18HSEN101	Communicative English	3	0	0	3
2	U18HSEN201	Technical English	3	0	0	3
3	U18HSEN501	Organizational Behavior	3	0	0	3
					Total Credits	9

List of Courses under Basic Sciences (BS)

S.No	Course Code	Course Name	L	T	P	C
1	U18BSMA101	Engineering Mathematics –I	3	1	0	4
2	U18BSPH 101	Waves and Optics	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	0	0	3
4	*U18BSPH2L1	Wave Optics and Mechanics Lab	0	0	3	0
5	*U18BSCH2L4	Chemistry Lab	0	0	3	0
6	U18BSMA201	Engineering Mathematics- II	3	1	0	4
7	U18BSPH201	Introduction to Mechanics	3	0	0	3
8	U18BSCH201	Environmental Sciences	3	0	0	3
9	U18BSBT101	Biology for Engineers	2	0	0	2
10	*U18BSPH2L1	Wave Optics and Mechanics Lab	0	0	3	1.5
11	*U18BSCH2L4	Chemistry Lab	0	0	3	1.5
12	U18BSMA302	Partial Differential Equations, Probability and Statistics	3	1	0	4
13	U18BSMA401	Numerical Methods	3	1	0	4
14	U18BSMA601	Operation Research	2	1	0	3
					Total Credits	36

List of Courses under Engineering Sciences (ES)

S.No	Course Code	Course Name	L	T	P	C
1	U18ESCS101	Problem Solving and Python Programming	3	0	0	3
2	U18ESME101	Engineering Graphics & Design	1	0	4	3
3	*U18BSPH2L1	Wave Optics and Mechanics Lab	0	0	3	0
4	U18ESCS1L1	Problem Solving and Python Programming Laboratory	0	0	3	1.5
5	U18ESEE101	Basic Electrical & Electronics Engineering	3	0	0	3
6	U18ESME1L2	Workshop/Manufacturing Practices Lab	1	0	4	3
7	U18ESEE1L3	Basic Electrical & Electronics Engineering Laboratory	0	0	3	1.5
					Total Credits	15

List of Courses under Professional Core (PC)

S.No	Course Code	Course Name	L	I	P	C
1	U18PCAU301	Solid Mechanics	3	0	0	3
2	U18PCAU302	Engineering Fluid Mechanics	3	0	0	3

3	U18PCAU303	Thermodynamics and Thermal Engineering	3	0	0	3
4	U18PCAU304	Materials Technology	3	0	0	3
5	U18PCAU305	Automotive Petrol Engines	3	0	0	3
6	U18PCAU3L1	Automotive Parts and Assembly Drawing	0	0	2	1
7	U18PCAU3L2	Fluid Mechanics and Strength of Materials Lab	0	0	2	1
8	U18PCAU401	Automotive Chassis	3	1	0	3
9	U18PCAU402	Automotive Electrical Systems	3	0	0	3
10	U18PCAU403	Design of Engine Components	3	1	0	4
11	U18PCAU404	Automotive Diesel Engines	3	0	0	3
12	U18PCAU405	Manufacturing Technology	3	0	0	3
13	U18PCAU4L1	Automotive Electrical & Electronics Lab	0	0	2	1
14	U18PCAU4L2	Manufacturing Technology Lab	0	0	2	1
15	U18PCAU4L3	Automotive Engines and Chassis Lab	0	0	2	1
16	U18PCAU501	Automotive Transmission	3	0	0	3
17	U18PCAU502	Automotive Aerodynamics	3	0	0	3
18	U18PCAU503	Electronic Engine Management System	3	0	0	3
19	U18PCAU504	Design of Chassis Components	3	1	0	4
20	U18PCAU5L1	Autotronics Lab	0	0	2	1
21	U18PCAU5L2	Engine Testing Emission Measurement Lab	0	0	2	1
22	U18PCAU601	Electric & Hybrid Vehicle	3	0	0	3
23	U18PCAU6L1	Two & Three Wheelers Lab	0	0	2	1
24	U18PCAU6L2	CAD/CAM Lab	0	0	2	1
25	U18PCAU701	Vehicle Dynamics	3	1	0	4
26	U18PCAU702	Vehicle Maintenance	3	0	0	3
27	U18PCAU602	Vehicle Body Engineering	3	0	0	3
28	U18PCAU7L1	Vehicle Dynamics Lab	0	0	2	1
29	U18PCAU7L2	Vehicle Maintenance Lab	0	0	2	1
					Total Credits	68

List of Courses under Employability Enhancement Courses (EE)

S.No.	Course Code	Course name	L	T	P	C
1	U18EEAU4S1	Technical Seminar-I	0	0	2	1
2	U18EEAU6S1	Soft Skill	0	0	1	1
3	U18EEAU6V1	Industrial Training /Internship	No Credit			
4	U18EEAU6P1	Project-I	0	0	6	3
5	U18EEAU8P2	Project-II	0	0	18	9
					Total Credits	14

List of Courses under Mandatory Courses (MC)

S.No.	Course Code	Course Name	L	T	P	C
1	U18MCAB101	Physical health – Sports & Games	0	0	2	0
2	U18MCAB102	Gardening & Tree Plantation -	0	0	2	0
3	18MCAB203	Yoga	0	0	2	0
4	18MCAB204	Physical health – NCC	0	0	2	0
5	U18MCAB305	Culture- Learning an art form	0	0	2	0
6	U18MCAB306	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	0	0	2	0
7	U18MCTH401	Constitution of India	0	0	2	0
8	U18MCAB407	Literature & Media –Literature, Cinema & Media	0	0	2	0
9	U18MCAB408	Literature & Media – Group Reading of Classics	0	0	2	0
10	U18MCAB509	Social Services – Social Awareness	0	0	2	0
11	U18MCAB510	Social Services – NSS	0	0	2	0
12	U18MCTH601	Essence of Indian Knowledge Tradition	2	0	0	0
13	U18MCAB611	Self Development – Spiritual, Mindfulness & Meditation	0	0	2	0
14	U18MCAB612	Self Development - religion and Inter-faith	0	0	2	0
15	U18MCAB713	Behavioral and interpersonal skills	0	0	2	0
16	U18MCAB714	Nature – Nature club	0	0	2	0
17	U18MCAB815	Innovation – Project based – Sc., Tech, Social, Design & Innovation	0	0	2	0
		Total Credits	0			

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms-phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 15

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management

9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	S										**S**	
2		**M**							**M**			
3			**S**							**S**		
4				**S**		**M**						
5					**S**		**S**	**W**				

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA101	**Engineering Mathematics – I (Common to B.Tech – Civil, Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, ECE, BME, CSE & IT)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

CO/PO Mapping S – Strong, M – Medium, W – Weak											
COs	**Programme Outcomes (POs)**										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	S				M		W			W	
CO2	S		S	W	M			M			
CO3	S				M				W		
CO4	S	M			M				W		
CO5	S		S		M				M	W	
Category	Basic Science (BS)										
Approval	47th Academic Council Meeting held in Aug, 2018										

			L	T	P	C
U18BSPH101	**Waves and Optics**		**3**	**0**	**0**	**3**
Pre-requisite	Higher Secondary School Physics					
Course designed by	Department of Physics					
OBJECTIVES:	To develop Physics fundamentals of Waves and Optics in order to formulate and discuss their functionalities in modern optoelectronics.					

			L	T	P	C
U18BSMA202	**Mathematics II for Bio Engineering** **(Common to IBT, Genetics and Agricultural Bio Tech)**		**3**	**1**	**0**	**4**
Pre-requisite	Prerequisite – School Level Mathematics					
Course designed by	Department of Mathematics					
OBJECTIVES:	To Enable the students to Learn and Understand the concepts of Mathematics to solve problems effectively in their respective fields of engineering.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION **9**

Introduction - Transverse wave on a stretched string - General solution for wave equation - Standing waves - Longitudinal waves and the wave equation - Acoustic waves - Energy and energy density of waves - Intensity - Reflection and transmission of waves at a boundary - Impedance matching - Speed of sound waves - Doppler effect.

UNIT 2 ULTRASONIC WAVES **9**

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS **9**

Fermat's principle of stationary time and its application to the laws of reflection and refraction. Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS **9**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A & B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

UNIT I ORDINARY DIFFERENTIAL EQUATIONS **9** **(9+3)**

Higher order linear differential equations with constant coefficients – Linear differe equations with variable coefficients – Euler's and Legendre's linear equations – Simultan first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables **(9+3)**

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a do integral – Triple integrals in Cartesian co-ordinates – Volume as triple integrals – Do integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS **9** **(9+3)**

Scalar and vector point functions – Gradient, Divergence and curl – Directional derivativ Angle between two surfaces – Irrotational and Solenoidal vector fields – Integration of v function – Green's theorem in a plane – Gauss divergence theorem and Stoke's theore Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS **(9+3)**

Functions of complex variable – Analytic functions – Necessary and sufficient condi Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properti analytic functions – Construction of analytic functions using Milne Thomson meth Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS **(9+3)**

Transforms of elem Functions – Inverse Laplace transform – Convolution theorem – Periodic Functio Applications of Laplace transform for solving linear ordinary differential equations up to se order with constant coefficient.

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) Brij Lal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) Ajoy Ghatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Programme Outcomes (POs)
S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**
2	CO1	S	S	M	S	M			M	S	S	
	CO2	W	S	M	M	S			M		W	S
	CO3	S	W			W			M	M		M
	CO4	S	W			W			M	M		M
	CO5	S	M	M	M				M		S	W
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications

	to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S			M		S		S		W	
CO2		W	S		M		S		M		W
CO3		M		S		W				M	
CO4	S		M	W			M			S	
CO5		S		W		M				S	
Category	Basic Science (BS)										
Approval	47th Academic Council Meeting held in Aug, 2018										

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and

methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	S	S	M	S	M	W		M	W	M
	CO2	S	S	M	M		M		W			M
	CO3	M	M	W	S	M		W		W		M
	CO4	M	M	W	M	S	M	W	M	W		M
	CO5	M	S	W	M	M			M	M	W	
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE4: SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by

using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)												
CO1	Students will gain Exposure to engineering communication.											
CO2	Students will learn standards of engineering graphics.											
CO3	Students will get Exposure to basics of building construction											
CO4	Students will get Exposure to computer-aided geometric design											
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering											
Mapping of Course Outcomes with Programme Outcomes (POs) (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S			M			S				
	CO2	S	S	W		S	M					
	CO3			S								
	CO4											S
	CO5	S						W				
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSPH2L1	**WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	L	T	P	C
		0	0	3	1.5
	Total Contact Hours - 45				
	Prerequisite – **Wave Optics and Mechanics**				
	Course designed by – Department of Physics				
OBJECTIVES: To impart Practical knowledge of Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle

5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics
1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

Course Outcome (CO's)												
CO1	Understand the fundamental concept of optics											
CO2	Understand the concept of production of ultrasonic waves											
CO3	Understand the basic concept of Mechanics											
Mapping of Course Outcomes with Programme Outcomes (POs) CO/SO Mapping:S – Strong M – Medium W-Weak												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S		S	S				S	W	M	
	CO2	S	S	W					S	W	M	
	CO3	S	S	W					S	M	M	
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)

CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Studentswill be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Students will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES
S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S		M	M		S		S		W	
CO2	W	S			M		S		M		W
CO3		M		M						M	
CO4	S		M				M				S
CO5		S		W		M				S	

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	K
2	CO1	S	S	M	S	S	M	M	M	M		M
	CO2	S	S	W	S	S	M	W	M	M	M	M
	CO3	S	S	M	M	M	M		M	M	M	M
	CO4	S	M	S	S	S	M	M	M	M	W	
	CO5	S	S	M	S	M	M		M	M	W	M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions – listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development – subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and

hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	M										**S**
2		**S**							**M**		
3			**S**							**S**	
4				**M**		**S**					
5					**M**		**M**	**W**			

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA201	**Engineering Mathematics II (Common to B.Tech – Civil, Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, ECE, BME, CSE & IT)**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex				

	variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.

CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M		W		S				M		S	
CO2	S	M			S			M		W		
CO3	S		W				M		S			
CO4								S	M	M	W	
CO5	S		W	W			M				S	
Cate	Basic Science (BS)											
App	47th Academic Council Meeting held in Aug, 2018											

U18BSPH201	**INTRODUCTION TO MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart basic knowledge of mechanics involving 1D, 2D and 3D motions ofa rigid body

UNIT 1 **9**

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2 **9**

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3 **9**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4 **9**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5 **9**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.

2. M.K. Harbola, “Engineering Mechanics”, 2nd edition, Cengage, 2013.
3. M.K. Verma, “Introduction to Mechanics”, 1st edition, CRC press, 2009.
4. D.Kleppner&R.Kolenkow, “An Introduction to Mechanics”, McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, “Engineering Mechanics – DynamicsVol 2”, 7th ed. Wiley, 2012
6. JP Den Hartog, “Mechanical Vibrations”, Dover Publications, Inc., 1985
7. WT Thomson, “Theory of Vibrations with Applications”, Pearson, 5th edition, 1997.
8. Online References: Wikipedia org

Course Outcomes

CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/PO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**
2	CO1		W	W					M	W	M	
	CO2	S	W	W	S				M	W	M	W
	CO3	M			M				S	M		
	CO4	S	W	W					M	W	M	W
	CO5	W	S	S	M				M	W	W	W
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of the Academic Council held in Aug, 2018										

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers,

consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.
Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their

	application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/SO Mapping: S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
CO1	S			M		S		S		W	
CO2	W	S	S		M		S		M		W
CO3		M				W			S	M	
CO4	S		M	W			M				M
CO5		S		W		M				S	

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation- nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis

Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)												
CO1	To understand the basic concepts of the cell and its structure											
CO2	To understand about biodiversity and its conservation											
CO3	To know the fundamentals of genetics and the immune system											
CO4	To create an awareness about human diseases											
CO5	To give a basic knowledge of the applications of transgenics											
CO6	To know the applications of bio systems in environment, medical and agricultural sectors											
Mapping of Course Outcomes with Programme Outcomes (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
1	COs/POS	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S					M	M			S	M
	CO2	S			M		S		M	M		
	CO3	M		M			M					
	CO4							S			M	M
	CO5	S	S					S	M	M		
	CO6	S						S				S
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.
Mapping of Course Outcomes with Programme Outcomes	

S- Strong, M-Medium, W- Weak												
1	COs/POS	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	W			M				S		W
	CO2	S	W			M				S		W
	CO3	S	M			M				S		W
	CO4	S	W			M				S		W
	CO5	S	W			M				S		W
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESME1L2	**Workshop/Manufacturing Practices Laboratory**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
   Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

6. Demonstration **(6 Hours)**
   Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POS	a	b	c	d	e	f	g	h	i	j	k
2	CO1											S
	CO2			S	M							S
	CO3		M									
	CO4	S			W							S
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter

6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S- Strong, M-Medium, W- Weak

1	COs/POS	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	S			S				S		M
	CO2	S	S			S				S		M
	CO3	S	S			S				S		M
	CO4	S	S			S				S		M
	CO5	S	S			S				S		M
	CO6	S	S			S				S		M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms-phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY

LIST OF EXPERIMENTS / EXCERCISES

13. Group discussion
14. Making effective presentations
15. Watching interviews & conversations
16. Reading different genres of texts
17. International English Language Testing System (IELTS)
18. Test of English as a Foreign Language (TOEFL)
19. Mock interviews

20. Time management &stress management
21. Role play
22. Listening to lectures, discussions from TV/ Radio.
23. Articulation of sounds - intonation.
24. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

5. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
6. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
7. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
8. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

MAPPING BETWEEN COURSE OUTCOMES& STUDENT OUTCOMES											
COs\SOs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	H										**H**
2		**M**							**M**		
3			**H**							**H**	
4				**H**		**M**					
5					**H**		**H**	**L**			

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA101	**Engineering Mathematics – I**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation

rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

3. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
4. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

6. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
7. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
8. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
9. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
10. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	SO1	**SO2**	**SO3**	**SO4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**
CO1	S				M		W			W	

CO2	S		S	W	M			M			
CO3	S				M				W		
CO4	S	M			M				W		
CO5	S		S		M				M	W	
Category	Basic Science (BS)										
Approval	47th Academic Council Meeting held in Aug, 2018										

U18BSPH101	**Mathematics II for Bio Engineering (Common to BT, Genetics and Agricultural Bio Tech)**	**L**	**T**	**P**	**L**	**C**	**T**	**P**	**C**
U18BSMA202	**Total Contact Hours - 45**	**3**	**0**	**0**	**3**				
	Prerequisite – Higher Secondary School Physics				**3**	**1**	**0**	**4**	
	Course designed by – Department of Physics								

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern communication systems.

Prerequisite	School Level Mathematics
Course Designed by	Department of Mathematics
OBJECTIVES	To make the students learn Mathematics in order to formulate and solve problems effectively in their respective fields of engineering.

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION **9**

Introduction - Transverse waves on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES **9**

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS **9**

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

UNIT 4 WAVE OPTICS **9**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power.

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium). Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

3) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
4) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

9) BrijLal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011

UNIT I ORDINARY DIFFERENTIAL EQUATIONS **(9+3)**

Higher order linear differential equations with constant coefficients – Linear differe equations with variable coefficients – Euler's and Legendre's linear equations – Simultan first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables **(9+3)**

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a do integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Do integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS **(9+3)**

Scalar and Vector point functions – Gradient, Divergence and Curl – Directional derivativ Angle between two surfaces – Irrotational and Solenoidal vector fields – Integration of v function – Green's theorem in a plane – Gauss divergence theorem and Stoke's theore Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS **(9+3)**

Functions of complex variable - Analytic functions – Necessary and sufficient condi Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properti analytic functions – Construction of analytic functions using Milne Thomson metho Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS **(9+3)**

Transforms of elementary functions – Basic properties – Shifting theorem- Transform derivatives and integrals – Initial and final value theorem – Laplace transform of Peri Functions – Inverse Laplace transform – Convolution theorem – Periodic Functio Applications of Laplace transform for solving linear ordinary differential equations up to se order with constant coefficient.

10) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
11) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
12) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
13) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
14) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
15) O. Svelto, "Principles of Lasers", Springer, 2010
16) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	**k**
2	CO1	H	H	M	H	M			M	H	H	
	CO2	L	H	M	M	H			M		L	H
	CO3	H	L			L			M	M		M
	CO4	H	L			L			M	M		M
	CO5	H	M	M	M				M		H	L
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNITI WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS **9**

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat

treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non-ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke – manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

6. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002).
7. S.S.Dara “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2006).
8. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).
9. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
10. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

3. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
4. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-

	conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S			M		S		S		W	
CO2		W	S		M		S		M		W
CO3		M		S		W				M	
CO4	S		M	W			M			S	
CO5		S		W		M				S	
Category	Basic Science (BS)										
Approval	47th Academic Council Meeting held in Aug, 2018										

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHIMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling

exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

3. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
4. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H	H	H	M	H	M	L		M	L	M
	CO2	H	H	M	M		M		L			M
	CO3	M	M	L	H	M		L		L		M
	CO4	M	M	L	M	H	M	L	M	L		M
	CO5	M	H	L	M	M			M	M	L	
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

SYLLABUS

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle;

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP;

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa;

MODULE4: SECTIONSOF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating

orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

6. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
7. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
8. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
9. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
10. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)												
CO1	Students will gain Exposure to engineering communication.											
CO2	Students will learn standards of engineering graphics.											
CO3	Students will get Exposure to basics of building construction											
CO4	Students will get Exposure to computer-aided geometric design											
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering											
Mapping of Course Outcomes with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H			M			H				
	CO2	H	H	L		H	M					
	CO3			H								
	CO4											H
	CO5	H						L				
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSPH2L1	**WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace, Auto & Nano Tech)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

7) Ultrasonic Interferometer
8) Air-wedge Experiment
9) Particle size determination
10) Determination of acceptance angle
11) Determination of Laser Wavelength
12) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics
7) Torsional Pendulum – without symmetrical mass
8) Torsional Pendulum – With symmetrical mass
9) Young's Modulus – Non-uniform bending
10) Young's Modulus – Uniform Bending
11) Compound Pendulum
12) Coefficient of viscosity of the given liquid – Poiseuille method

Course Outcome (CO's)												
CO1	Understand the fundamental concept of optics											
CO2	Understand the concept of production of ultrasonic waves											
CO3	Understand the basic concept of Mechanics											
Mapping of Course Outcomes with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H		H	H				H	L	M	
	CO2	H	H	L					H	L	M	
	CO3	H	H	L					H	M	M	
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method

6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization an well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COURSE OUTCOMES (COs) WITH Programme Outcomes (POs)
S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S		M	M		S		S		W	
CO2	W	S			M		S		M		W
CO3		M		M						M	
CO4	S		M				M				S
CO5		S		W		M				S	

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				

OBJECTIVES: To enhance the practical knowledge on writing programs using Python

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	K
2	CO1	H	H	M	H	H	M	M	M	M		M
	CO2	H	H	L	H	H	M	L	M	M	M	M
	CO3	H	H	M	M	M	M		M	M	M	M
	CO4	H	M	H	H	H	M	M	M	M	L	
	CO5	H	H	M	H	M	M		M	M	L	M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

15. Compute the GCD of two numbers.
16. Find the square root of a number (Newton‘s method)
17. ExSOnentiation (SOwer of a number)
18. Find the maximum of a list of numbers
19. Linear search and Binary search
20. Selection sort, Insertion sort
21. Merge sort
22. First n prime numbers
23. Multiply matrices
24. Find the most frequent words in a text read from a file
25. Simulate elliptical orbits in Pygame
26. Simulate bouncing ball using Pygame
27. Simulate matrix operations with Scilab
28. Simulate fitting curve with NumPy and Matplotlib

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

	TECHNICAL ENGLISH	**L**	**T**	**P**	**C**
U18HSEN201	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology–

introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\SOs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	M										**H**
2		**H**							**M**		
3			**H**							**H**	
4				**M**		**H**					
5					**M**		**M**	**L**			

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

	Engineering Mathematics II	**L**	**T**	**P**	**C**
U18BSMA201	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

5. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
6. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
7. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
8. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.
CO/PO Mapping	

S – Strong, M – Medium, W – Weak												
COs	**Programme Outcomes (POs)**											
	SO1	**SO2**	**SO3**	**SO4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**	**SO12**
CO1	M		W		S				M		S	
CO2	S	M			S			M		W		
CO3	S		W				M		S			
CO4								S	M	M	W	
CO5	S		W	W			M				S	
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH201	**INTRODUCTION TO MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart basic knowledge of mechanics involving 1D, 2D and 3D motions of a rigid body

UNIT 1 **9**

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2 **9**

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3 **9**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4 **9**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5 **9**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

2. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

9. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.
10. M.K. Harbola, "Engineering Mechanics", 2nd edition, Cengage, 2013.

11. M.K. Verma, "Introduction to Mechanics", 1st edition, CRC press, 2009.
12. D.Kleppner&R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education, 2017
13. JL Meriam and L.G.Kraige, "Engineering Mechanics – DynamicsVol 2", 7th ed. Wiley, 2012
14. JP Den Hartog, "Mechanical Vibrations", Dover Publications, Inc., 1985
15. WT Thomson, "Theory of Vibrations with Applications", Pearson, 5th edition, 1997.
16. Online References: Wikipedia org

Course Outcomes

CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

Mapping of Course Outcomes with Programme Outcomes (POs)

1	COs/POs	a	b	c	d	e	f	g	h	i	j		**k**
2	CO1		L	L					M	L	M		
	CO2	H	L	L	H				M	L	M		L
	CO3	M			M				H	M			
	CO4	H	L	L					M	L	M		L
	CO5	L	H	H	M				M	L	L		L
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of the Academic Council held in Aug, 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				

OBJECTIVES

- To study the interrelationship between living organism and environment.
- To study of the nature and concepts of ecosystem.
- To learn about the integrated themes and biodiversity of an environment.
- To study of pollution control and waste management.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION **9**

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL SOLLUTION **9**

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN SOPULATION **9**

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their

	application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/SO Mapping: S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S			M		S		S		W	
CO2	W	S	S		M		S		M		W
CO3		M				W			S	M	
CO4	S		M	W			M				M
CO5		S		W		M				S	

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System - types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

4. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
5. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
6. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

7. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
8. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
9. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)												
CO1	To understand the basic concepts of the cell and its structure											
CO2	To understand about biodiversity and its conservation											
CO3	To know the fundamentals of genetics and the immune system											
CO4	To create an awareness about human diseases											
CO5	To give a basic knowledge of the applications of transgenics											
CO6	To know the applications of bio systems in environment, medical and agricultural sectors											
Mapping of Course Outcomes with Students Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H					M	M			H	M
	CO2	H			M		H		M	M		
	CO3	M		M			M					
	CO4							H			M	M
	CO5	H	H					H	M	M		
	CO6	H						H				H
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS 12

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC

circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transformations Theorem.

MODULE 2: AC CIRCUITS 9

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS 9

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS 6

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

3. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
4. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.

REFERENCES:

3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Programme Outcomes (POs) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H	L			M				H		L
	CO2	H	L			M				H		L
	CO3	H	M			M				H		L
	CO4	H	L			M				H		L
	CO5	H	L			M				H		L
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESME1L2	**Workshop/Manufacturing Practices Lab (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

3. Machine shop **(6 hours)**
- d) Facing
- e) Turning
- f) Drilling Practice

4. Fitting shop **(6 hours)**
- c) Fitting Exercises–Preparation of square fitting
- d) Vee–fitting models.

3. Carpentry **(9 hours)**
- a) Preparation Lap joints.
- b) Mortise and Tenon joints.
- c) Cross Half.
- d) Dove Tail.

10. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and tee joints

11. Sheet Metal working **(9 hours)**
- d) Forming & Bending:
- e) Model making–Trays, funnels, etc.
- f) Different type of joints

12. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

6. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.

7. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
8. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

9. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

10. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies

	and dimensional tolerances.											
CO4	Students will be able to produce small devices of their interest.											
Mapping of Course Outcomes with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1											H
	CO2			H	M							H
	CO3		M									
	CO4	H			L							H
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronic Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration

4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H	H			H				H		M
	CO2	H	H			H				H		M
	CO3	H	H			H				H		M
	CO4	H	H			H				H		M
	CO5	H	H			H				H		M
	CO6	H	H			H				H		M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSMA302	**Partial Differential Equations, Probability and Statistics**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVE	Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms. Learn techniques of solving the standard types of first order and second order partial differential equations. Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem. Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases. Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample				

UNIT I FOURIER SERIES (9+3) Hrs

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS (9+3) Hrs

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3) Hrs

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT 1V PROBABILITY DISTRIBUTION (9+3)Hrs

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS (9+3)Hrs

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. S.C.Gupta& V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi , 2003. [Units I to III].

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability for Engineers" , 6th Edn. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.
CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.
CO5	Learn the basic idea of statistics including measures of central tendency .Identify the appropriate hypothesis testing procedure based on type of outcome variable and number of samples.

CO/PO Mapping	**S – Strong, M – Medium, W – Weak**											
COs	**Program Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**

CO1	M				S	M	W	W	M			
CO2	M	S	W		S	M	W			M	M	
CO3	S	S	M	W				W		W		
CO4	S	S	M	W			W		M		S	
CO5	S	S		W		M	W	W			S	
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCAU301	**SOLID MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Introduction to Mechanics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in Solid Mechanics. The detailed concept, stresses in beams, Deflection of beams will be taught to the students. Stresses in helical springs and biaxial stresses will also be introduced to the students.

MODULE 1 INTRODUCTION TO SOLID MECHANICS 9

Definition of stress, strain and their relations – Relations between material constants – Axial loading - Statically determinate and indeterminate problems in tension & compression – Plane truss analysis – method of joints – method of sections – 3-D trusses – Thermal stresses –Impact loading.

MODULE 2 STRESS IN BEAMS 9

Shear force & bending moment diagrams: Bending and shear stress variation in beams of Symmetric sections, a typical spar section: Beams of uniform strength - beams of two materials.

MODULE 3 DEFLECTION OF BEAMS 9

Double integration method – Macaulay's method – moment area method – conjugate beam Method – principle of superposition – Maxwell's reciprocal theorem.

MODULE 4 TORSION – SPRINGS- COLUMNS 9

Torsion of solid and hollow circular shafts – shear stress variation – open and closed-coiled helical springs – stresses in helical springs – classification of columns – Euler buckling – columns with different end conditions.

MODULE 5 BIAXIAL STRESSES 9

Stresses in thin-walled pressure vessels – combined loading of circular shaft with bending, torsion and axial loadings – Mohr's circle and its construction – determination of principal stresses.

TEXT BOOKS

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi 2014.

2. R S Khurmi Strength of Materials, KHANNA Publications New-Delhi 2014.

REFERENCE BOOKS

1. Nash W.A, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co, New York, 2012
2. Kazimi S.M.A, Solid Mechanics, Tata McGraw-Hill Publishing Co, New Delhi, 2011
3. Ryder G.H, Strength of Materials, Macmillan India Ltd., Third Edition, 2012
4. Ray Hulse, Keith Sherwin & Jack Cain, Solid Mechanics, Palgrave ANE Books, 2014.
5. Singh D.K, Mechanics of Solids" Pearson Education 2012.

Course Outcomes															
CO1 - Acquire the knowledge on basics of Solid Mechanics															
CO2 - Attain the knowledge of stress acting on the beams															
CO3 - Gain the knowledge of deflection of beams															
CO4 - Obtain the acquaintance in loading on shaft, springs, columns															
CO5 - Develop the basic understanding of Biaxial Stresses															
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M				M							L	H	
	CO2	H	H		M								M	H		H
	CO3	H	M	H	H									H	M	M
	CO4	H	M	H	M		M	M	M				L		H	H
	CO5	H	L		M											L
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU302	**ENGINEERING FLUID MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in Engineering Fluid Mechanics. The detailed concept, Basic theory of Engineering Fluid Mechanics, Basic Equations of fluid Flow Analysis, Incompressible In viscid flow, Incompressible viscous flow and Fluid machinery will be taught to the students.

MODULE 1 BASIC CONCEPTS 8

Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

MODULE 2 FLUID KINEMATICS & FLUID DYNAMICS 9

Fluid Kinematics: Fluid Kinematics – Flow visualization – Lines of flow – types of flow – velocity field and acceleration– continuity equation (one and three dimensional forms) Equation of stream line - stream function - velocity potential function – flow net.
Fluid Dynamics: Introduction - Euler's equations of motion – Bernoulli's equation from Euler's equation – Bernoulli's equation for real fluid – Applications of Bernoulli's equation – Venturimeter, orificemeter – pitot tube.

MODULE 3 BOUNDARY LAYER FLOW 9

Introduction – Laminar boundary layer – Turbulent boundary layer – boundary layer thickness – drag force on a flat plate due to boundary layer – velocity profiles – turbulent boundary layer on a flat plate.

MODULE 4 INCOMPRESSIBLE FLUID FLOW 9

Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's)-Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation – pipe roughness - friction factor - Moody's diagram - minor losses - flow through pipes in series and in parallel

MODULE 5 FLUID MACHINERY 9

Introduction and classification of fluid machines – Turbo machinery analysis – The angular momentum principle – Euler turbo machine equation– Application to fluid systems – Working principle of turbines, fans, blowers, pumps and compressors.

TEXT BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd., New Delhi, 2014.
2. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 2014.
3. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 2012.

REFERENCE BOOKS

1. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2013.
2. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd edition, 2014.
3. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 2013.
4. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7^{th} edition), 2014.

Course Outcomes
CO1 - Apply the fundamental concepts in the design of flow measuring devices
CO2 - Apply the basic laws in fluid kinematics
CO3 - Apply the governing equation in fluid dynamics
CO4 - Analyze incompressible fluid flow through pipes
CO5 - Demonstrate and analyze the performance of hydraulic turbines

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M	M	H	L	L						M	L	H	
	CO2	M	H	H				L						M		H
	CO3	H	H	M	L								M	H	M	M
	CO4	M	H	H	M		L						L		L	H
	CO5	H	M	L	M		M									L
3	Category	Professional Core (PC)														
4	Approval	47^{th} Meeting of Academic Council held in Aug, 2018														

U18PCAU303	**THERMODYNAMICS AND THERMAL ENGINEERING**	**L**	**T**	**P**	**C**

	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Physics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in Engineering Thermodynamics. The detailed concept, Basic Thermodynamics, Air cycle and Compressors, Refrigeration and Air-conditioning, Heat Transfer and Heat exchangers will be taught to the students.

MODULE 1 BASIC THERMODYNAMICS 12

Systems, Zeroth low, First law. Properties of gases and vapours. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement - Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes.

MODULE 2 AIR STANDARD CYCLES AND THEIR ANALYSIS 12

Carnot, Stirling, Ericsion, Otto, Diesel, Dual and Air standard efficiency. Mean effective pressure, comparison of Otto, Diesel, Dual cycles- Problems on Otto and Diesel cycles

Actual Cycles and their analysis-Exhaust blow down – Heat loss factor – Actual volumetric Efficiency.

MODULE 3 REFRIGERATION AND AIR-CONDITIONING 9

Principles of Psychometry and refrigeration - Vapour compression - Vapour absorption types -Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning.

MODULE 4 HEAT TRANSFER 9

Conduction in parallel, radial and composite wall – Basics of Convective heat transfer - Fundamentals of Radiative heat transfer.

MODULE 5 HEAT EXCHANGERS 9

Types of Heat Exchangers- Radiators-Types- Design of Parallel, Counter and Cross flow Heat Exchangers. **(**Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

TEXT BOOKS:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005**.**

REFERENCES:

1. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

Course Outcomes
CO1 –To learn the detailed study of zeroth and first law of thermodynamics
CO2 – To learn detailed study of Air cycle and Compressors
CO3 – To learn detailed study and types of Refrigeration and Air conditioning
CO4 – To learn detailed study of Heat Transfer
CO5 – To learn detailed study of Heat exchangers and its types
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H										L	L	H	
	CO2	H	M			L								M		L
	CO3	H	H	M	M								M	H	H	M
	CO4	H	H	M	M	L	L						L		H	H
	CO5	M		H	M	L	L						L			L
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU304	**MATERIAL TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Physics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in Automotive Petrol Engines. The detailed concept, fuel supply system cooling and lubrication system and combustion and combustion chambers and other petrol engines will be taught to the students.

MODUEL 1 CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectroid reactions, Iron - Iron carbide equilibrium diagram. Classification of steel and cast Iron micro-structure, properties and application.

MODULE 2 HEAT TREATMENT 9

Definition - Full annealing, stress relief, recrystallisation and spheroidizing - Normalising, hardening and Tempering of steel. Isothermal transformation diagrams - Cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test - Austempering, martempering - Case hardening, carburising, nitriding, cyaniding, carbonitriding - Flame and Induction hardening

MODULE 3 SELECTION OF MATERIALS 9

Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring. Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel , clutch plate, axle, bearings, chassis, spring, body panel, radiator, brake lining.

MODULE 4 NON-METALLIC MATERIALS 9

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers - Urea and Phenol formaldehydes - Engineering Ceramics - Properties and applications of Al2O3, SiC, Si3N4, PSZ and Sialon - Fiber and particulate reinforced composites.

MODULE 5 MECHANICAL PROPERTIES AND TESTING 9

Mechanism of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.

TEXT BOOKS

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2012.

REFERENCE BOOKS

1. William D Callister "Material Science and Engineering", John Wiley and Sons 2012
2. Raghavan.V.Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 2010
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw-Hill Book Company 2012

Course Outcomes
CO1 - The students should be able to Familiarize on the constitutions of alloys and their phase diagrams
CO2 - The students should be able to understand the various heat treatment process
CO3 - The students should be able to gain knowledge on the selection criteria of materials
CO4 - The students should be able to attain knowledge about the non-metallic materials
CO5 - The students should be able to develop knowledge on the mechanical properties and testing of materials

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M											H	L	
	CO2	L	M											M		L
	CO3	L	M										L	H	H	H
	CO4	L	L	L		L	H	M	L						M	H
	CO5	L		M		M	H	M	L				L			L
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU305	**AUTOMOTIVE PETROL ENGINES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Thermodynamics and Thermal Engineering				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

To impart knowledge on Gasoline fuel injection system, requirement, Components and types of ignition and combustion system and various emissions and alternative fuels for S.I. Engines

MODULE 1 INTRODUCTION TO SI ENGINES 9

Construction and Working principle of SI Engine, Four stroke and Two stroke Engines, Comparison of Four stroke and Two stroke Engines, Classification of SI Engines, applications of SI Engines, Fuels for SI Engines, Conventional and Alternate Fuels for IC Engines.

MODULE 2 COMBUSTION IN S.I. ENGINES 9

Stages of combustion in SI Engines, normal and abnormal combustion, Flame front propagation, Flame speed, Rate of Pressure, The phenomenon of Knock in SI Engines, Combustion chambers for SI Engines, Smooth Engine operation, High power output and Thermal efficiency.

MODULE 3 ENGINE LUBRICATION AND COOLING 9

Introduction- Direct Frictional Loses, Pumping Loses, Power Loss to drive, Mechanical Efficiency, Mechanical Friction, Blowby Loses, Pumping Loses, Factors affecting Mechanical friction, Lubrication, Lubrication of Engine components, Types of Lubrication system, Crankcase Ventilation, Properties of Lubricants, SAE Rating of Lubricants, Additives for Lubricants, Need for Cooling system, Characteristics of an Efficient Cooling System, Types of Cooling Systems, Liquid Cooling Systems, Air Cooled System, Comparison of Liquid and Air Cooling Systems

MODULE 4 EMISSIONS IN SI ENGINE AND CONTROL 9

Introduction, Air Pollution due to IC Engines, Emission norms, Comparison between Bharat Stage and Euro norms, Engine Emissions, Hydrocarbons (HC), Hydrocarbon Emissions, Carbon Monoxide (CO) Emission, Oxides of Nitrogen (NO_x), Other Emissions, Emission Control Methods, Catalytic Converters, Non Exhaust Emissions, Modern Evaporative Emission Control System, Crankcase Blowby.

MODULE 5 SUPERCHARGING AND TURBOCHARGING 9

Introduction-Supercharging, Types of Superchargers, Effects of Supercharging, Limitations of Supercharging, Thermodynamic Analysis of Supercharged Engine Cycle, Gear driven and Exhaust Driven Supercharging Arrangements, Turbo charging.

TEXT BOOKS:

1. Ganesan V, Internal Combustion Engines, McGraw Hill Education (India) Private Limited, 2012.
2. Ramalingam, K.K., Internal Combustion Engines, SciTech Publications (India) Pvt. Ltd., 2004.

REFERENCES

1. B.P. Pundir Engine Combustion and Emission, 2011, Narosa Publishing House.
2. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998.
3. Mathur, M.L., and Sharma, R.P., A Course in Internal Combustion Engines, Dhanpat Rai Publications Pvt. New Delhi-2, 1993.
4. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers,1983.

Course Outcomes

CO1 - To learn Gasoline Air mixture requirements and supply system

CO2 - To learn Gasoline injection and ignition system

CO3 - To learn combustion in SI engines

CO4 – To learn liquid and gaseous fuels for SI engine

CO5 – To learn emissions from SI engine

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H	H	L		M	L					M	L	H	H
	CO2	H	H	H	M		M	M					L	H	M	M
	CO3	H	H	H	M		M	L					M		H	
	CO4	H	M	H	L		M						L	H	L	H
	CO5	H	H	H	M		M	L					M	H		H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU3L1	**AUTOMOTIVE PARTS AND ASSEMBLY DRAWING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**2**	**1**
	Prerequisite – Engineering Graphics				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVES					
The main objective of this Study is to Design and drawing practice of Automotive Parts.					

MODULE I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

MODULE 2 INTRODUCTION TO 2D DRAFTING 16

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.

- Bearings - Bush bearing, Plummer block
- Valves – Safety and non-return valves.
- Cams and Followers

MODULE 3 3D GEOMETRIC MODELING AND ASSEMBLY 17

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section - Assembly

- Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

TEXT BOOK:

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013
2. Narayana K.L., Kannaiah P and Venkata Reddy – "Production Drawing" New Age International Limited, Delhi 2004.

REFERENCES:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata Mc GrawHill,2006
4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007.

Course Outcomes																
CO1 - To learn Gasoline Air mixture requirements and supply system																
CO2 - To learn Gasoline injection and ignition system																
CO3 - To learn combustion in SI engines																
CO4 – To learn liquid and gaseous fuels for SI engine																
CO5 – To learn emissions from SI engine																
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M	M	L	M							M	M	H	H
	CO2	H	M	L	L									H	H	L
	CO3	M	H	L	L	M							L		H	
	CO4	H	M	M	M	L								H	H	M
	CO5	M	M	L	M								M	H		H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU3L2	**FLUID MECHANICS & STRENGTH OF MATERIALS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**2**	**1**
	Prerequisite – Solid Mechanics, Fluid Mechanics & Machinery				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					
The main objective of this Study is to lab practice of fluid flows, Determination of Flow through notches, weir and orifice. The practical study of strength of materials.					

LIST OF EXPERIMENTS

FLUID MECHANICS LAB

1. Determination of flow through pipes, losses in pipes.
2. Calibration of orificemeter and venture meter.
3. Flow through notches and weir.
4. Flow through open orifice.
5. Buoyancy experiment-Metacentric height.
6. Impact of jet on vanes-inclined and curved vanes.
7. Verification of Bernoulli's equation.

FLUID MACHINERY LAB

1. Performance characteristics of Jet pump
2. Performance characteristics of Vane pump
3. Performance characteristics of Centrifugal pump
4. Performance characteristics of Reciprocating pump
5. Performance characteristics of Gear pump

6. Characteristics of Impulse turbine
7. characteristics of Reaction turbine

STRENGTH OF MATERIALS LAB

1. Tension test of a mild steel rod
2. Double shear test on mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Hardness test on metals- Brinell and Rockwell hardness
5. Deflection test on helical springs
6. Deflection test on beams
7. Double shear test in U.T.M
8. Impact test on Metals

Course Outcomes															
CO1 - Determination of flow through pipes, losses in pipes.															
CO2 - Calibration of orificemeter and venture meter.															
CO3 - Performance characteristics of pumps and turbines.															
CO4 – Tension and Torsion test of a mild steel rod															
CO5 - Deflection test on helical springs, beams and Impact test on Metal															
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M		M	L				L	M	M	L	H	M	L
	CO2	H	H			L					M	M		H	H	
	CO3	H	H		M					L		M	L			L
	CO4	H	M		M	M				L	L		M		M	
	CO5	H	M		L	L					L	M	M	H		M
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18BSMA401	**Numerical Methods**	**L**	**T**	**P**	**C**
	Total Contact Periods: 60	**3**	**1**	**0**	**4**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT 1 SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS **12 Hrs**

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT 2 INTERPOLATION **12 Hrs**

Finite differences - Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-

Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT 3 NUMERICAL DIFFERNTIATION AND INTEGRATION 12 Hrs

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT 4 INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION 12 Hrs

Single step methods- Taylor series, Euler and modified Euler methods, Runge Kutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's - Bash forth predictor and corrector methods.

UNIT 5 BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATION 12 Hrs

Finite difference - solution of 2^{nd} order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for one dimensional wave equation.

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5^{th} edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42^{nd} Edition, 2016.
3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005.

REFERENCE BOOKS

1. Curtis F. Gerald. "Applied Numerical Analysis" 7th Edn. Pearson Education,
2. Dennis G. Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jones & Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K. Gunavathi - Numerical methods, S.Chand & Company, 2^{nd} Edition 2010.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO2	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO3	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Be exposed Taylor's series and Runge-Kutta methods to solve initial value problems of ODE
CO5	Student will be able to solve two dimensional Laplace, Poisson equations and one dimensional heat and wave equations of PDE.

	AUTOMOTIVE CHASSIS	**L**	**T**	**P**	**C**
U18PCAU401	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					

The main objective of this course is to impart knowledge in Automotive Chassis. The detailed concept of Introduction, Frame, Steering system, Propeller shaft and final drive, Axles and Tyres, Suspension system and Braking system will be taught to the students.

MODULE 1 INTRODUCTION 9

Types of chassis layout with reference to power plant locations and drives, vehicle frames, various types of frames, monocoque structure, constructional details, materials, testing of vehicle frames, auto body styles.

MODULE 2 FRONT AXLE AND STEERING SYSTEM 9

Types of front axles, construction details, materials, front wheel geometry: castor, camber, king pin inclination, toe-in. conditions for true rolling motion of wheels during steering, steering geometry, Ackermann steering system, constructional details of steering linkages, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering, steering of crawler tractors and Electronic Steering System.

MODULE 3 DRIVE LINE 9

Effect of driving thrust and torque reactions, Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential unit, non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, fully floating, three quarter floating and semi floating rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles, wheels and tyres.

MODULE 4 SUSPENSION SYSTEM 9

Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, rubber suspension, pneumatic suspension, shock absorbers, independent suspension, semi-active and active suspension system.

MODULE 5 BRAKING SYSTEM 9

Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, material, hydraulic system, vacuum assisted system, air brake system, antilock braking system, retarded engine brakes, eddy retarders and electronic braking system.

TEXT BOOKS

1. James D. Halderman , ‘Automotive Chassis Systems’, Pearson Series, 2017.
2. Kirpal Singh - "Automobile Engineering, Vol.1 "- Standard Publishers Distributors, New Delhi - 2013
3. NK. Giri – Automobile Engineering - Khanna Publishers – 2015

REFERENCE BOOKS

1. Newton, Steeds and Garrotte- “The Motor Vehicles"- Butterworths, London- 2000.
2. Jornsen Reimpell , Helmut Stoll and Jurgen Betzler , “ The Automotive Chassis: Engineering Principles”, 2001.
3. Tim Gilles, “Automotive Chassis”, CENGAGE Delmar Learning, 2004.

Course Outcomes
CO1 - Understand the basic knowledge about various vehicle frames and steering systems.

CO2 - Understand the construction and working principle of final drives.
CO3 - Gain knowledge about rear axle and types of tires
CO4 - To identify the suspension springs for different applications
CO5 - To suggest suitable braking systems for different types of automobiles
CO6 - Able to realize the importance of braking systems in a vehicle and possess knowledge about ABS and EBS

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H			M								M		H	H
	CO2	H	M										M		H	H
	CO3	H			M								M		H	H
	CO4	M		H									M		H	H
	CO5	H	M										M		H	H
	CO6					H									H	H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council, Aug 2018														

U18PCAU402	AUTOMOTIVE ELECTRICAL SYSTEMS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electrical and Electronics				
	Course Designed by- Department of Automobile Engineering				

Objective:

- Knowledge in vehicle electrical and electronics components for engine operation.
- Enhancing the knowledge on microprocessor applications in vehicle control systems.
- Gaining information's on modern safety system in vehicle braking.

MODULE 1 BATTERIES **8**

Principle and construction of lead-acid battery. Characteristics of battery, rating, capacity and efficiency of batteries. Various tests on battery condition, charging methods - Modern storage batteries- Nickel-Iron and others-Batteries for electric cars-Limitations

MODULE 2 STARTING SYSTEM **9**

Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

MODULE 3 CHARGING SYSTEM **9**

Function, Components of DC and AC Charging System for Automobile, construction, operating principle, characteristics, charging circuit controls – cut out, relays, voltage and current regulators, troubleshooting, new developments.

MODULE – 4 IGNITION SYSTEM **9**

Types, construction & working of battery coil and magneto ignition systems. Relative merits,

centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, Glow Plug, Electronic Ignition systems. Distributor Less Ignition systems.

MODULE – 5 LIGHTING SYSTEM & ACCESSORIES 9

Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. LED lighting system, Head light dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system, Trafficator, wiring system.

TEXT BOOKS

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press-reprint 2010.
2. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, reprint 2010.

REFERENCE BOOKS

1. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi, reprint 2011
2. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2010.

CO1 - Familiarize with lead acid battery and accessories.
CO2 - Acquire the knowledge of starting system.
CO3 - Develop the knowledge on charging system.
CO4 - Gain knowledge on automotive electronics.
CO5 - Gain the information about sensors and activators.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	M	H	M		H							M	H	H	H
	CO2	H	M	M		H							M	H	H	H
	CO3	M	H	M		M							L	M	H	H
	CO4	H	H	M		H								H	H	H
	CO5	H		M									L	H	H	H
	CO6	M			H									M	L	H
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18PCAU403	**DESIGN OF ENGINE COMPONENTS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Solid Mechanics				
	Course Designed by- Department of Automobile Engineering				

Objective: To make the students understand the design concept and principles of various engine components. These concepts and principles are familiarized for design of components.

MODULE 1 INTRODUCTION **12**

Engineering materials and their physical properties applied to design, selection of materials, factor of safety, endurance limit, notch sensitivity, principles of design optimization, future trends, computer aided drafting.

MODULE 2 LIMITS, FITS, TOLERANCES, SURFACE FINISH, SHAFTS AND SPRINGS 12

Definitions, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness, design of power transmission shafts, and design of helical springs.

MODULE 3 DESIGN OF CYLINDER AND PISTON **12**

Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

MODULE 4 DESIGN OF CONNECTING ROD, CRANKSHAFT **12**

Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, connecting rod failures, balancing of I.C. Engines, significance of firing order, material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations.

MODULE 5 DESIGN OF VALVES AND FLYWHEEL **12**

Design aspects of intake and exhaust manifolds, inlet and Exhaust valves, valve springs, tappets, valve train. Materials and design of flywheel.

TEXT BOOKS

1. R.K. Jain, "Machine Design", Khanna Publishers, New Delhi, 2012.
2. "Design Data Book", PSG College of Technology, Coimbatore, 2015.
3. P.M.Heldt "High Speed Combustion Engines", Oxford-IBH Publishing Co., Calcutta, 2011.

REFERENCE BOOKS

1. A.Kolchin and V.Demidov, "Design of Automotive Engines", MIR Publishers, Moscow, 2014.
2. Sundararaja Murthy T.V "Machine Design", Khanna Publishers, New Delhi, 2011.
3. R.S.Khurmi, Machine design, 2015

Course Outcomes
CO1 - Familiarize on various types of materials and their properties.
CO2 - Acquire knowledge on geometrical dimensioning.
CO3 - Develop the knowledge on design procedure of various engine components
CO4 – Develop the knowledge of designing connecting rod and crankshaft
CO5 - Acquire knowledge of designing valves
CO6 - Acquire knowledge of designing flywheel

Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	H	H	L							L	M	H	H	H
	CO2	H	H	H	M								L	L	H	H
	CO3	H	H	H	M								M	H	H	H
	CO4	H	M	H	H							M	L	L	H	M
	CO5	H	H	M	L								M	M		H
	CO6		M			H							H		H	
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18PCAU404	AUTOMOTIVE DIESEL ENGINES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Thermodynamics and Thermal Engineering				
	Course Designed by- Department of Automobile Engineering				

Objectives:

To Understand the intake, exhaust, fuel injection system and combustion in diesel engines
To impart knowledge on various alternative fuels for C.I Engines
To identify the nature of pollutant formation and control in C I engines.

MODULE - 1 BASIC THEORY AND INTAKE AND EXHAUST MANIFOLDS 8

Diesel engine construction and operation. Two stroke and four stroke diesel engines. Diesel cycle – Fuel-air and actual cycle analysis. Diesel fuel. Ignition quality. Cetane number. Intake system components, Air filter, Intake manifold, Turbochargers, Exhaust manifold and exhaust pipe, Exhaust mufflers and Resonators.

MODULE – 2 DIESEL INJECTION SYSTEMS 9

Direct and indirect injection systems, Inline injection pump, Rotary Pump and Injector– Construction and principle of operation, Electronic control, Common rail and unit injector systems – Construction and principle of operation.

MODULE – 3 COMBUSTION IN C.I. ENGINES 10

Stages of combustion, vapourisation of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion.

MODULE – 4 LIQUID AND GASEOUS FUELS FOR C.I. ENGINES 9

Requirements, Utilisation techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.Utilisation techniques of gaseous fuels-Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines. Dual fuelling.

MODULE – 5 EMISSIONS FORMATION AND CONTROL TECHNIQUES 9

Carbon Monoxide, Unburnt Hydrocarbons, Oxides of Nitrogen, Particulate matter and smoke – sources. Emission control measures for CI engines. Effect of emissions on environment and human beings.

TEXT BOOKS:

1. Ramalingam, K.K., Internal Combustion Engines, SciTech Publications (India) Pvt. Ltd., 2004.
2. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 2003.
3. Rajput R.K. Internal Combustion Engines, Laxmi Publications (P) Ltd, 2006.

REFERENCES:

1. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998.
2. B.P. Pundir Engine Combustion and Emission, 2011, Narosa Publishing House.
3. Mathur, M.L., and Sharma, R.P., A Course in Internal Combustion Engines, Dhanpat Rai Publications Pvt. New Delhi-2, 1993.
4. Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engines, 2007, Second Edition, Pearson Prentice Hall.

Course Outcomes
CO1 - Understand the various components of the engine and its functions
CO2 - Understand the fuel injection system in CI engines.
CO3 - Optimize the combustion process in CI Engine for better performance with reduced emissions
CO4 - Apply the Supercharging, Turbo charging and Scavenging Concepts in I.C Engines to enhance the combustion process
CO5 - Design Analyze and optimize the complete engine and its subsystems for better efficiency
CO6 - Knowledge about the recent development in the area of engines.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H		M									M		H	H
	CO2	H											M		H	H
	CO3			H		M									H	H
	CO4	M			H										H	H
	CO5		M	H		M									H	H
	CO6	H											M		H	H
3	Category		Professional Core (PC)													
4	Approval		47^{th} Meeting of Academic Council, Aug 2018													

U18PCAU405	**MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Mechanical Engineering				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					

The automobile components such as piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., are manufactured by various types of production processes involving casting, welding, machining, metal forming, power metallurgy etc. Hence B.E. Automobile Engineering students must study this course Production Technology.

MODULE 1 CASTING **8**

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

MODULE 2 WELDING **8**

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

MODULE 3 MACHINING **13**

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining.

MODULE 4 FORMING AND SHAPING OF PLASTICS **7**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods

MODULE 5 METAL FORMING AND POWDER METALLURGY **9**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

TEXT BOOKS

1. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., “Elements of Manufacturing Processes”, Prentice-Hall of India Private Limited, 2007.

REFERENCES

1. Adithan. M and Gupta. A.B., “Manufacturing Technology”, New Age, 2006.
2. “H.M.T. Production Technology – Handbook”, Tata McGraw-Hill, 2000.
3. Jain. R.K. and S.C. Gupta, “Production Technology”, Khanna Publishers. 16th Edition,2001.
4. Roy. A. Linberg, “Process and Materials of Manufacture”, PHI, 2000.

5. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education, Inc. 2007.

Course Outcomes															
CO1 - Understand various metal casting process, principle and procedure															
CO2 - Understand the process, principle of various types of welding and its applications															
CO3 - Understand the various machining process															
CO4 - Understand the industrial applications of forming and shaping of plastics															
CO5 - Understand the process, principle and procedure of powder metallurgy															
CO6 - Understand the process, principle of metal forming process															
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H	L									L		H	H
	CO2	M	H	L	L					L			M		H	
	CO3	M	M	H	L			L					L		H	H
	CO4	H	M	H											H	H
	CO5	H				M							M		H	
	CO6		M		H											H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU4L1	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Basic Electrical and Electronics				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					
To introduce the testing procedure for electrical and electronics system in automobile.					

LIST OF EXPERIMENTS

AUTOMOTIVE ELECTRICAL LAB

1. Battery testing
2. Alternator testing.
3. Starter motor testing.
4. Diagnosis of ignition system.
5. Diagnosis of automotive electrical wiring.
6. Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).
7. Relay & fuse Fault diagnostic of a car using OBDS

AUTOMOTIVE ELECTRONICS LAB

1. Characteristics of rectifiers and filters
2. Study of IC timer
3. Study of Microprocessor 8085
4. Simple ALP program using 8085 MEL Kit
5. Data acquisition from sensors using 8085 MEL Kit

6. Interfacing of stepper motor with 8085 MEL Kit
7. Fault finding location of sensor in car using OBDS

Course Outcomes															
Familiarize with various testing procedures of Battery, Alternator and Starter motor.															
Acquire the Diagnosis of ignition system and automotive electrical wiring.															
Develop the Skills on Off Board Diagnostics Systems (OBDS) procedure.															
Gain the knowledge about the rectifier, IC timer and microprocessor 8085.															
Acquire the skill on ALP program, Interfacing and data acquisition using 8085 MEL Kit															
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M		L	M						L		H		H
	CO2	H	M		L	M					L		M	H	H	
	CO3	H		H	M	L								H		H
	CO4	M	H			M						M	M	H	H	H
	CO5	M	H		M	L					L		M		H	H
	CO6			M								M				H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU4L2	**MANUFACTURING TECHNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Workshop Technology				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					
To make the student understand various process, capabilities of lathe, drilling machine, milling machine and shaper machine					

LIST OF EXPERIMENTS

1. Cylindrical surface process
2. Lathe – Taper turning and external thread cutting
3. Drilling machine – Drilling, Tapping & Reaming
4. Milling process – Surface milling
5. Gear manufacturing process – spur gear, gear hobbing
6. Shaping process – keyway cutting
7. Surface finishing process – surface grinding, cylindrical grinding

Course Outcomes
Ability to use different machines depending on job profile requirement
Ability to use different machine tools depending on job surface requirement
Ability to manufacture single point cutting tool using cutter grinder
Ability to manufacture gear through generation process
Ability to use different grinding machine process
Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	M	L		M					M		M	H		H
	CO2	H	M		L							M		H	H	
	CO3	H	H	M		M			M		M		L	H		H
	CO4	M	H	M	L	M							L	H	H	
	CO5	M	M	H	L						L		M			M
	CO6			M	H									H	H	
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU4L3	**AUTOMOTIVE ENGINE AND CHASSIS COMPONENTS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Automotive Chassis and Engines				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					
To dismantle and assembling of engine and chassis components					

LIST OF EXPERIMENTS

Automotive Engine Components

1. Dismantling, Study and Assembling of Multi Cylinder SI Engine
2. Dismantling, Study and Assembling of Multi Cylinder C I Engine
3. Study of oil filter, fuel filter, fuel injection system and carburetor
4. Study of MPFI and CRDI Systems
5. Study of Ignition Systems – Battery coil, Magneto and Electronic
6. Study of engine cooling system components
7. Study of engine lubrication system components

Automotive Chassis Components

1. Study and measurement of the chassis frames: Heavy duty vehicle & Light duty vehicle
2. Dismantle, study and assemble of Front Axle, Rear Axle and Differential
3. Dismantle study and assemble of various Steering systems.
4. Dismantle, study and assemble of various Braking systems – including ABS
5. Dismantle, study and assembling of dependent and independent suspension systems
6. Dismantle, study and assembling of various clutch assemblies
7. Dismantle, study and assembling of various gear boxes and transfer case

Course Outcomes
Ability to use different machines depending on job profile requirement
Ability to use different machine tools depending on job surface requirement
Ability to manufacture single point cutting tool using cutter grinder
Ability to manufacture gear through generation process

Ability to use different grinding machine process																
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	M	L		M					M		M	H		H
	CO2	H	M		L							M		H	H	
	CO3	H	H	M		M			M		M		L	H		H
	CO4	M	H	M	L	M							L	H	H	
	CO5	M	M	H	L						L		M			M
	CO6			M	H									H	H	
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18EEAU4S1	**TECHNICAL SEMINAR-I**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	1	1
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE					
The students know about the resent techniques in Automobile Evaluation will be made based on the reports, the presentations and the interactions during the question answer sessions.					

The students are expected to make presentations throughout the semester under the supervision of a team of respective department faculty. The students are to be grouped appropriately so that each student makes a minimum of two different presentations on engineering topics of current interest. Every student has to submit an approved technical report prior to his presentation. Evaluation will be made based on the reports, the presentations and the interactions during the question answer sessions.

Course Outcomes																
CO1 –Ability and Skills to be improved																
CO2 – self confidents to be improved																
CO3 –leadership quality to be improved																
CO4 –innovative ideas will be generated																
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M	M		L					L		L	H		
	CO2	H	M	M		M						M	M	H		
	CO3	H	H			M					L	M	M	H		H
	CO4	H	M	M									L			H
	CO5	H	M	M		L					M	L	M	H		
	CO6	H			H									H		H
3	Category	EE														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU501	**AUTOMOTIVE TRANSMISSION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE

The main objective of this course is to impart knowledge in Automotive Transmission. The detailed concept of Clutch and Gear Box, Hydrodynamic Drive, Planetary Gear Boxes, Automatic Transmission Applications, Hydrostatic and Electric Drive will be taught to the students.

MODULE – 1 CLUTCH AND GEAR BOX 10

Requirement of transmission system. Different types of clutches, principle, Construction and torque capacity. Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox.

MODULE – 2 HYDRODYNAMIC DRIVE 9

Fluid coupling - Principle of operation, Constructional details, Torque capacity, Performance characteristics and Reduction of drag torque. Hydrodynamic Torque converter - Principle of operation, Constructional details and Performance characteristics. Multistage torque converters. Polyphase torque converters. Converter coupling

MODULE – 3 PLANETARY GEAR BOXES 8

Construction and operation of Ford – T-model gearbox, Wilson Gear box and Cotal electromagnetic transmission.

MODULE 4 AUTOMATIC TRANSMISSION APPLICATIONS 9

Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Electronically operated transmission system. Case study for the transmission of Nissan, Mercedes Benz, Toyota.

MODULE 5 HYDROSTATIC AND ELECTRIC DRIVE 9

Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive. Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations.

TEXT BOOKS:

1. Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
2. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
3. Devaradjane. G., Kumaresan. M., "Automobile Engineering", AMK Publishers, 2013.

REFERENCES:

1. SAE Transactions 900550 & 930910.
2. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
3. Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains construction", McGraw Hill, 1976.
4. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002

Course Outcomes
CO1 - Understand the fundamentals, principle of operation and performance of various clutches and gear boxes.
CO2 - Gain the knowledge about various hydrodynamic drives.
CO3 – Conceive various types of gear boxes used for Automotive transmission
CO4 - Understand the principle of operation and performance of various hydrostatic drives
CO5 - Understand the principle of operation and performance of various electric drives
CO6 - Compare various types of transmission system

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	L	M										M	H	M
	CO2	M	M	L		M								M	H	M
	CO3		M	M	M									M	H	M
	CO4	H			M									M	H	M
	CO5	H			M									M	H	M
	CO6					H								M	H	M
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18PCAU502	**AUTOMOTIVE AERODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Fluid Dynamics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body.

MODULE I INTRODUCTION **9**

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics.

MODULE II AERODYNAMIC DRAG OF CARS 9

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

MODULE III SHAPE OPTIMIZATION OF CARS 9

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.

MODULE IV VEHICLE HANDLING 9

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles and racing cars.

MODULE V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. CFD analysis.

TEXT BOOKS

1 W.H. Hucho, 'Aerodynamics of Road Vehicles', Butterworth and Co., 2014.
2 A. Pope, "Wind Tunnel Testing", 2nd Edition, John Wiley & Sons New York,

REFERENCE BOOKS

1 E.L.Houghton & P.L.Carpenter, "Aerodynamics for Engineering students", Butterworth Heinman(2013)
2 Milliken and Milliken, "Race Car Vehicle Dynamics".

Course Outcomes
CO1 - Understand the importance aerodynamics for automobiles
CO2 - Able to calculate drag on car
CO3 - Analyze various aerodynamic shapes of car.
CO4 - Understand about the stability of vehicle
CO5 - Apply the concept of wind tunnel for aerodynamic design of automobiles.
CO6 - Able to use wind tunnel for calculating aerodynamic performance of car model

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	3													3	3
	CO2		3												3	3
	CO3			3		2									3	3

	CO4	3		2											3	3
	CO5					3									3	3
	CO6			2		3									3	3
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18PCAU503	ELECTRONIC ENGINE MANAGEMENT SYSTEM	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Electrical & Electronics				
	Course Designed by – Dept of Automobile Engineering				
OBJECTIVES: To explain the principle of engines and vehicle electronic management system and different sensors used in the systems.					

MODULE 1 FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 6

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines.

MODULE 2 SENSORS 9

Types – Mass Air flow, Manifold Absolute Pressure, Throttle, Temperature, Speed, EGO, Knock, and Crankshaft Position-Hall Effect-Principle of operation, construction, material and characteristics.

MODULE 3 SI ENGINE MANAGEMENT 9

Mono point, Multi point and direct injection systems - Principles and Features, Bosch injection systems- L-Jetronic and LH –Jetronic- Layout and working, Open loop control and Lambda loop control in injection.

MODULE 4 CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Inline injection pump, Rotary pump and injector - Construction and principle of operation, electronically controlled Unit Injection system. Layout of the common rail fuel injection system.

MODULE 5 IGNITION SYSTEMS AND ENGINE MAPPING 12

Ignition fundamentals, Types of solid state ignition systems, High energy ignition distributors, Electronic spark timing and control. Combined ignition and fuel management systems. Digital control techniques - Dwell angle, Ignition timing and Injection duration calculation.

TEXT BOOKS

1. Bosch Technical Instruction Booklets.
2. Tom Denton, Automotive Electrical and Electronic Systems, Edward Amold.
3. William B Ribbens “Understanding Automotive Electronics”, SAE Publications.
4. Eric Chowanietz “Automobile Electronics” SAE Publications.

REFERENCE BOOKS

1. Robert Bosch "Diesel Engine Management" SAE Publications.
2. Robert Bosch, "Gasoline Engine Management" SAE Publications.
3. Robert N.Brady, "Automotive Computers and Digital Instrumentation", Prentice Hall.
4. Duffy Smith, Auto Fuel Systems, The god Heart Willcox Company Inc., Publishers.
5. Heinz Heisler, Advanced Engine Technology. SAE Publications.

Course Outcomes
CO1 - Study of modern control strategies like Fuzzy logic and adaptive control
CO2 - Understand the role of various sensors and actuators
CO3 - Ability to know construction and working principle of sensors and its influence in controlling pollution
CO4 - Describe the ignition and injection methods used in an SI engine
CO5 - Describe the fuel injection systems in a diesel engine and the emission control systems
CO6 - Explain the electronic systems used in the fuel control system and the dash board unit.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H		L										M	H	M
	CO2		H											M	H	M
	CO3	M												M	H	M
	CO4			H										M	H	M
	CO5	M				H								M	H	M
	CO6	H												M	H	M
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18PCAU504	**DESIGN OF CHASSIS COMPONENTS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite –				
	Course Designed by – Dept of Automobile Engineering				
OBJECTIVES: At the end of the course, the student can able to design the automotive components like frame, suspension systems, axles, clutch, gear box, drive line components etc					

MODULE 1 DESIGN OF CLUTCHES **9+3**

Design of single plate clutch, multi plate clutch, centrifugal clutch and cone clutch; energy dissipated by clutches, torque transmission capacity of clutches, design of clutch components.

MODULE 2 DESIGN OF GEAR BOX **9+3**

Performance of vehicles, total resistances to vehicle motion, traction and tractive effort, geometric progression for calculation of gear ratios, design of three speed and four speed gear ratios.

MODULE 3 DESIGN OF CHASSIS FRAME AND SUSPENSION 9+3

Study of loads, moments and stresses on Chassis frame members, design procedure of ladder type chassis frame, design procedure of leaf springs, coil springs and torsion bar springs.

MODULE 4 DESIGN OF FRONT AXLE AND STEERING SYSTEMS 9+3

Study of loads, moments and stresses on front axle, design procedure of front axle; Condition for true rolling motion, Ackermann steering principles, calculation of turning circle radius.

MODULE 5 DESIGN OF PROPELLER SHAFT AND REAR AXLE 9+3

Design procedure of propeller shaft, design procedure of rear axles.

TEXT BOOKS

1. Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2012
2. Khurmi. R.S. & Gupta. J.K., "A textbook of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.

REFERENCE BOOKS

1. An Introduction to Modern Vehicle Design. Editor, Julian Happian-Smith. Edition, illustrated, reprint. Publisher, SAE International, 2014.
2. Handbook of Vehicle Design Analysis by John Fenton, 9781560919032

Course Outcomes
CO1 - Acquire the knowledge on design of various types of clutches.
CO2 - Familiarize on the performance of vehicles and design of gear ratio calculations.
CO3 - Attain knowledge on design of ladder type chassis frame and suspension components.
CO4 - Obtain the knowledge on design procedure of front axle
CO5 - Gain the knowledge on design of propeller shaft and rear axle.
CO6 - Obtain the knowledge on design procedure of steering systems.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/ POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H	H	L							L	M	H		H
	CO2	H	M	H	M								L	H		H
	CO3	M	H	H	M								M	H		H
	CO4	H	M	H	H								L	H		H
	CO5	H	H	L	L							M	M	H		H
	CO6	M		M		H								H		H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU5L1	**AUTOTRONICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite –				

	Course Designed by- Department of Automobile and Mechatronics Engineering
OBJECTIVE	
Study and performance of pneumatic and hydraulic applications in automobiles	

LIST OF EXPERIMENTS

1. Design and testing of hydraulic circuits such as
   a) Pressure control
   b) Flow control
   c) Direction control
   d) Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer.
2. Design and testing of pneumatic circuits such as
   (a) Pressure control (b) Flow control
   (b) Direction control (d) Circuits with logic controls
   (f) Circuits with timers
   g) Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
3. Design of speed control circuits
   a) Meter – In Circuit
   b) Meter – Out Circuit
4. Design of continuous cycle circuit
5. Design of synchronizing circuit
6. Design of sequence circuit

Course Outcomes															
CO1 –Design and testing of hydraulic circuits															
CO2 – Design and testing of pneumatic circuits															
CO3 – Design of speed control circuits and Design of synchronizing circuit															
CO4 – Design of sequence circuit															
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	Cos /POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M	L			M			L			M	H	H	H
	CO2		H	M								L		H	H	H
	CO3	M	L	M	M		H			L			M	H	M	H
	CO4	H		M								L	L	H	M	H
	CO5		H		M					M				H	M	
	CO6	H							H						H	H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18LCAU5L2	**ENGINE PERFORMANCE AND EMISSION TESTING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Automotive Petrol and Diesel Engines				
	Course Designed by- Dept of Automobile Engineering				

OBJECTIVE: To conduct performance test and emission test on the IC engines.

LIST OF EXPERIMENTS

1. Study of hydraulic, electrical and eddy current dynamometers
2. Valve timing and port timing diagrams
3. Performance and emission test on two wheeler SI engine
4. Performance and emission test on automotive multi-cylinder SI engine
5. Performance and emission test on automotive multi-cylinder CI engine
6. Retardation test on I.C. Engines.
7. Heat balance test on automotive multi-cylinder SI engine
8. Heat balance test on automotive multi-cylinder CI engine
9. Morse test on multi-cylinder SI engine
10. Flash, Fire and Pour Point Measurement of a fuel
11. Motoring test for indicated power

Course Outcomes																
CO1 – Study of Dynamometers																
CO2 – Performance study of Petrol and Diesel engines																
CO3 – Study of balance Test																
CO4 – Study of Emission Test and Exhaust gas Analyzer																
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	M	L			M			L			M	H	H	H
	CO2		H	M								L		H	H	H
	CO3	M	L	M	M		H			L			M	H	M	H
	CO4	H		M								L	L		H	H
	CO5		H		M					M				H		H
	CO6	H							H					M	H	H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18BSMA601	**Operations Research For Engineers (common to B.Tech - Mech, Mechatronics & Automobile)**	**L**	**T**	**P**	**C**
	Total Contact periods: 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics I & II and statistics				
	Course Designed by Department of Mathematics				
OBJECTIVES	To provide the student with the concept and an understanding of basic concepts in Linear Programming techniques, Duality Principles, Transportation and Assignment problems, Inventory models, PERT/CPM, Queuing and Replacement Models.				

UNIT I LINEAR PROGRAMMING 9 Hrs

Introduction to phases of an Operations Research study– Linear programming – Formulation of the Programming – Graphical method – Simplex method – Dual simplex method-Two phase method.

UNIT II TRANSPORTATION &ASSIGNMENT PROBLEMS 9 Hrs

Transportation models – Vogel's approximation method MODI method – Unbalanced transportation problem – Degeneracy in transportation models **-** Assignment problems – Hungarian method

UNIT III NETWORKS & REPLACEMENT MODELS 9Hrs

Networks – PERT and CPM – Network diagrams – Shortest route – Minimum spanning tree, Replacement models– Individual and Group replacement policy

UNIT IV INVENTORY MODELS 9 Hrs

Inventory models – Deterministic models – Production models – Economic Ordering Quantity Models – Quantity Discount Model – Multi Product Models – Inventory Control Models in practice.

UNIT V QUEUEING MODELS & RESOURCE SCHEDULING 9Hrs

Queuing theory – Queuing system and structure – Kendal's notation– Poisson arrival and Exponential service time – Characteristic of queuing models – Single channel and multiple models. Resource scheduling – Sequencing of n- jobs through 2 machines and 3 machines.

TEXT BOOKS

1. Gupta and Hira D.S " Operations Research", S. Chand & Co, New Delhi, 2006
2. H. A. Taha, "Operations Research", Prentice Hall of India, 2002, Seventh Edition 2007.

REFERENCE BOOKS

1. Kanti Swarup, Gupta P.K., and Manmohan, "Operations Research", Sultan Chand & Sons 1997. Paneerselvam R., Operations research, Prentice-Hall of India, New Delhi, 2001.
2. T. Veerarajan, "Operations Research", Published by Orient Black Swan, 2010.

COURSE OUTCOMES (COs)	
CO1	To Explain the basic concepts of optimization and to formulate and solve linear programming problems, Apply duality principle in day to day life style.
CO2	Apply the concepts of Transportation Problem and Assignment Problem, Participate in the class room discussion on Transportation algorithm.
CO3	Explain and demonstrate the basic concepts of PERT- CPM and their application, reproduce the network model.
CO4	Explain the basic concepts of optimization and to formulate and solve inventory problems.
CO5	Explain and apply the concepts of Queueing theory, sequencing problem and their application.

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Program Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	S	S		S			M	M			W	
CO2	S	S	M		M					W		
CO3	S	S		M	S	W						
CO4	S	S	S	M	W				W			
CO5	S						W	M	S			
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18PCAU601	**ELECTRIC AND HYBRID VEHICLE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Electrical and Electronics, Computer Control of Vehicle Systems				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To understand the principle, working and design of electric and hybrid vehicles.					

MODULE 1- ELECTRIC VEHICLES **9**

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

MODULE 2- ELECTRIC PROPULSION SYSTEMS & GENERATORS **9**

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking. DC generators, AC generators, voltage and frequency regulations

MODULE 3- HYBRID VEHICLES **9**

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

MODULE 4- MOTOR CONTROLLERS AND CONTROL SYSTEMS & ENERGY STORAGES **9**

Control system principles, speed and torque control – DC motors and AC motors. Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra-capacitors.

MODULE 5- FUEL CELLS & SOLAR CARS **9**

Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar carsphotovoltaic cells, tracking, efficiency and cost comparison.

TEXT BOOKS

1. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRS Press, 2014.
2. James Larminie and John Loury, “Electric Vehicle Technology-Explained”, John Wiley & Sons Ltd., 2013.

REFERENCE BOOKS

1. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Butterworth –Heinemann, 2012.
2 Donwhite Consultant Incorporate – Handbook of EMI / EMC – Vol I – 2015
3 Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2012
4 Ron Hodkinson and John Fenton, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth- Heinemann, 2011.

COURSE OUTCOMES (COs)
CO1 - The students should be able to Familiarize on concepts of electric vehicle & performance of electric vehicles
CO2 - The students should be able to Gain knowledge on Electric Propulsion Systems & Generators

CO3 - The students should be able to Acquire the knowledge on hybrid electric drive train systems																
CO4 - The students should be able to Attain the knowledge on Energy Storages																
CO5 - The students should be able to Attain the knowledge on Fuel Cells & Solar Cars																
CO6 - The students should be able to Attain the knowledge on Control Systems																
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	Cos /POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H						L	H		H
	CO2	H	H				H							H		H
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	M					M	H		H
	CO5	M	H	H	L		L							H		H
	CO6	H			H									H		H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU6L1	**TWO AND THREE WHEELERS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					
To train the students to conduct performance test on two and three wheelers To train the students to dismantle and assemble the gear box, steering system etc.,					

LIST OF EXPERIMENTS

1. Performance test of a two wheeler using chassis dynamometer.
2. Performance test on shock absorber
3. Performance test on coil spring.
4. Two wheeler chain test
5. Brake and Clutch adjustment as per specification.
6. Dismantling and assembling of two wheeler gear box and finding gear ratios
7. Dismantling and assembling of three wheeler box and finding gear ratios
8. Three wheeler brake and clutch play adjustment
9. Dismantling and assembling of three wheeler steering system.
10. Study of three wheeler chassis frame and power transmission system.

Course Outcomes
CO1 - Graduates will have basic knowledge of testing of two wheeler vehicles
CO2 - Able to dismantle and assemble of clutch and brake system used in two wheeler
CO3 - Able to dismantle and assemble of gear box used in two wheeler and find out gear ratios
CO4 - Able to measuring the dimensions of three wheeler chassis
CO5 - Able to dismantle and assemble of front fork assembly used in two wheeler
Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	M	L				L				M	M	H	H	
	CO2	H		L		M					L			H	H	
	CO3		M	L								M	M	H	H	
	CO4	H	L			M		M						H	H	
	CO5	M	M	L				L			L		M		H	
	CO6	H			H				H					H	H	
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU6L2	**CAD / CAM LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Technical and Machine Drawing, Engineering Graphics, Computer Integrated Manufacturing, CAD-CAM, AutoCAD and Pro-E Basics				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					
Study of Computer aided drafting and manufacturing					

LIST OF EXPERIMENTS

COMPUTER AIDED DRAFTING

CAD introduction to computer aided drawing, 2D drawing Orthographic view, Isometric views, 2D -Sectional views , Part drawing, Assembly drawing, Detailed drawing, Dimensioning, Annotations, Symbols, Welding, Surface finish, Threads, Text, Bill of materials. Exercise - Knuckle Joint, Gib and Cotter Joint, Screw Jack, Foot step Bearing.

3D drawing part modeling - Protrusion, Cut Sweep, Draft and Loft-Modify/ Edit - Pattern-Transformation, Boolean operation. Assembly - creating assembly from parts, Modify / Edit - Pattern conversion of 3D solid model to 2D model. Surface modeling - Tabulated, Revolve, Ruled and edge surfaces, Exercise-Piston, Connecting Rod, Knuckle Joint, Universal Joint and Couplings.

COMPUTER AIDED MANUFACTURING

1. Manual Part programming for CNC machines using a standard G-codes and M-codes. Simulation of tool path, machining practice on trainer type CNC machines - straight cut, Taper turning, Profile, Parting, Thread cutting.
2. CNC milling machines; Production of various contour shapes.
3. Computer assisted part programming-APT PROGRAMMING LANGUAGE - Part programming using APT and other NC programming languages.
4. Introduction to component modeling.
5. NC code generation using CAD/CAM software - Post Processing for standard CNC controls like FANUC, SIMUMERIC etc.,

Course Outcomes
CO1 –CNC milling machines; Production of various contour shapes.
CO2 – Introduction to component modeling.
CO3 – NC code generation using CAD/CAM software
CO4 – Manual Part programming for CNC machines using a standard G-codes and M- codes.
Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	H	L				L				H	M	H	H	
	CO2	H		L		M			L		L			H	H	
	CO3		M	L								M	M	H	H	
	CO4	H	L			M		H						H	H	
	CO5	M	M	L				L			L		M	H	H	
	CO6	H			H									H	H	
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PCAU701	VEHICLE DYNAMICS	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					
To know about the application of basic mechanics principles for dynamic analysis of vehicles.					

MODULE 1 CONCEPT OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed.

MODULE 2 TIRES 9

Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on Various road surfaces. Tire vibration.

MODULE 3 VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. Design and analysis of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

MODULE 4 LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Tire forces, rolling resistance, Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

MODULE 5 LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Stability of vehicle on banked road, during turn. Effect of suspension on cornering.

TEXT BOOKS:

1. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005
2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992
4. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001

REFERENCES:

1. Dean Karnopp, "Vehicle Stability", 1st edition, Marcel Dekker, 2004
2. Hans B Pacejka, "Tire and Vehicle Dynamics", 2nd edition, SAE International, 2005
3. John C. Dixon," Tires, Suspension, and Handling", 2nd edition, Society of Automotive Engineers Inc, 1996
4. Jan Zuijdijk, 'Vehicle dynamics and damping", Author House, 2009
5. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier Limited, 2004
6. Nakhaie Jazar. G., "Vehicle Dynamics: Theory and Application", 1st edition, Springer, 2008

Course Outcomes
CO1 - Understand the concept of mechanical vibrating system
CO2 - Understand fundamentals of vibration theory and familiar with basics of vibrations and their mathematic models.
CO3 - Gain knowledge about the suspension and tire related vibrations
CO4 - Analyze the performance, ride and handling mode of the vehicle.
CO5 - Understand about the stability of vehicle
CO6 - Equip themselves about the vibration control techniques.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H													H	H
	CO2	M	H												H	H
	CO3	H		M											H	H
	CO4			H											H	H
	CO5	H													H	H
	CO6					H									H	H
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council, Aug 2018														

U18PCAU702	**VEHICLE MAINTENANCE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				

	Course Designed by- Department of Automobile Engineering

OBJECTIVE:

The main objective of this course is to impart knowledge maintenance records and schedule, maintenance, repair and overhauling of chassis drive line components, maintenance, repair and servicing of electrical systems, maintenance, repair and servicing of cooling, lubrication system, fuel system and body will be taught to the students.

MODULE 1 MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 10

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE 2 ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 8

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls

MODULE 3 TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE 4 STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE 10

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system

MODULE 5 AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 9

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, and evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis. Vehicle body repair like panel beating, tinkering, and soldering, polishing, painting.

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, 2003.
2. Vehicle Service Manuals of reputed manufacturers

REFERENCE:

1. Bosch Automotive Handbook, Sixth Edition, 2004

Course Outcomes
CO1 - Gain knowledge about vehicle operation and maintenance, service schedules etc.

CO2 - Gain skills in handling situations where the vehicle is likely to fail.
CO3 - Understand maintenance procedures like repairing, overhauling etc.,
CO4 - Understand the concept of fault diagnosis
CO5 - Understand the various advances in fault diagnosis
CO6 - Understand the auto electrical and air-conditioning maintenance

Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H													H	M
	CO2	H													H	M
	CO3	H				M									H	M
	CO4		M												H	M
	CO5				H										H	M
	CO6	M				H									H	M
3	Category	Professional Core (PC)														
4	Approval	47th Meeting of Academic Council, Aug 2018														

U18PCAU703	**VEHICLE BODY ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Chassis				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					
The main objective of this course is to impart knowledge of car body details, Vehicle aerodynamics, bus body details, commercial vehicle details, body materials, trim and mechanisms will be taught to the students.					

MODULE 1 CAR BODY DETAILS **9**

Types car bodies – Visibility: regulations, driver's visibility, methods of improving visibility – Safety: Safety Design, constructional details of roof, under floor, bonnet, boot, wings etc

MODULE 2 BUS BODY DETAILS **9**

Types of bus bodies. Floor height, engine location – Entrance and exit location, Constructional details, frame construction, Double skin construction, Types of metal sections used, regulations, Conventional and integral type construction.

MODULE 3 VEHICLE AERODYNAMICS **9**

Objects – Vehicle drag and types. Various types of forces and moments. Effects of forces and moments various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Tests with scale models

MODULE 4 COMMERCIAL VEHICLE DETAILS AND BODY MATERIALS **9**

Types of bodies – Flat platform, drop side, fixed side, tipper body, tanker body. Construction

of commercial vehicle bodies. Dimensions of driver's seat in relation to controls. Drivers cab design. Steel sheet, timber, plastics, GRP, properties of materials. Corrosion: Anticorrosion methods, Modern painting process. Body trim items – Body mechanisms.

MODULE 5 BODY LOADS AND STRESS ANALYSIS 9

Scaled structure – Structural surface – Shear panel method – Symmetric and Asymmetrical vertical loads in a car – Longitudinal loads – Different loading situations – Load distribution on vehicle structure – Stress analysis of bus body structure under bending and torsion – Stress analysis in integral bus body. Analysis of shock and impulse.

TEXTBOOK:

1. Powloski, J., 'Vehicle Body Engineering', Business Books Ltd., 2012
2. John Fenton, 'Vehicle Body Layout and Analysis', Mechanical Engineering Publication Ltd., London, 2013

REFERENCES:

1. Giles, G.J., Body construction and design, lliffe Books Butterworth & Co., 1991.
2. Dieler Anselm., The passenger car body, SAE International, 2000.
3. John Fenton, "Vehicle Body Layout and Analysis", Mechanical Engineering Publication Ltd., London.

Course Outcomes
CO1 - Understand the fundamentals of various automotive body construction details
CO2 - Understand the concepts of aerodynamics in body engineering for better style and low drag.
CO3 - Familiarize various aerodynamic effects of vehicle body shape
CO4 - Know about different aspects of car body and bus body, types, commercial vehicle.
CO5 - Role of various aerodynamic forces and moments, measuring instruments
CO6 - Know about the material used in body building, tools used, body repairs.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H												H	M	M
	CO2	M		H										H	M	M
	CO3	H												H	M	M
	CO4	M			H									H	M	M
	CO5	H												H	M	M
	CO6	M				H								H	M	M
3	Category		Professional Core (PC)													

4	Approval	47th Meeting of Academic Council, Aug 2018

U18LCAU7L1	**VEHICLE DYNAMICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Vehicle Dynamics				
	Course Designed by- Department of Automobile and Mechatronics Engineering				
OBJECTIVE					
Study and performance of stability of vehicle under test conditions					

LIST OF EXPERIMENTS

1. Testing of natural frequency
2. Measurement of displacement velocity and acceleration
3. Whirling of Shafts
4. Critical Speed Determination
5. Camber angle measurement
6. Modal Analysis of given structure

Course Outcomes
CO1 - Find the natural frequency of the given model
CO2 - Study vibration characteristics of a vehicle using quarter car / half car model
CO3 – Find the displacement, Velocity and acceleration with the use of Mathematical software using various sensors
CO4 - Familiarize using MATLAB- SIMULINK software to solve simple mechanical systems
CO5 - Familiarize using Multi Body dynamics software to solve simple Car model
CO6 - Analyze the Dynamic modeling and simulations of road vehicles and their subsystems.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1		3												2	
	CO2	3													2	
	CO3	2			3										2	
	CO4					3									2	
	CO5			3											2	
	CO6		3			2									2	
3	Category		Professional Core (PC)													
4	Approval		47th Meeting of Academic Council, Aug 2018													

U18LCAU7L2	VEHICLE MAINTENANCE LABORATORY	L	T	P	C
	Total Contact Hours - 45	0	0	2	1
	Prerequisite – Vehicle Maintenance				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE

Study of an automobile repair, service and maintenance shop.

LIST OF EXPERIMENTS

1. Study of an automobile repair, service and maintenance shop.
2. Study and preparation of different statements/records required for the repair and maintenance works.
3. Study of different types of tools and instruments required for repair and Maintenance.
4. Engine tune up for Diesel and Petrol Engines.
5. Fault diagnosis in electrical ignition system, gasoline fuel system, diesel fuel system.
6. Study of the faults in the electrical systems such as headlights, side or parking lights, electric horn system, windscreen wiper system, starting and lighting system.
7. Study of fuel filters and air cleaners.
8. Study and adjustment of pedal play in clutch, hand brake and steering wheel play.
9. Practices on air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
10. Removal and fitting of tires and tubes.

Course Outcomes

CO1 - Prepare the Workshop layout and statements

CO2 - Understand about the tools and equipment's used in automotive workshop

CO3 - Able to perform a major and minor tune up of gasoline and diesel engines and will be calibrate the fuel pump

CO4 - Ability to identify the faults and knowledge on maintenance of various sub systems in the vehicle

CO5 - Able to diagnose and service the engine and transmission system using scan tool

CO6 - Removal and fitting of tire and tube.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H												M		H
	CO2	H												M		H
	CO3	M				H								M		H
	CO4				H									M		H
	CO5			M	H									M		H
	CO6	M				H								M		H
3	Category		Professional Core (PC)													
4	Approval		47^{th} Meeting of Academic Council, Aug 2018													

U18EEAU7P1	Project Work Phase - I	L	T	P	C
	Total Contact Hours –	0	0	3	3
	Prerequisite – Professional Courses				
	Lab Manual Prepared by – Dept of Automobile Engineering				

OBJECTIVES

To teach the student the procedures and methodologies for understanding the literature survey and preparation for research paper.

Students should model, analyze and animate /fabricate a functional model of any component, subsystem or a mechanism used in automobile. They should prepare a design project report and submit.The assessment will be done on a continuous basis as follows:

Review / Exam	Weightage
1st Review	20%
2nd Review	20%
3rd Review	20%
Report	20%
Final Viva	20%
Total	**100%**

COURSE OUTCOMES (COs)

CO1 - To identify the area of research.

CO2 - To prepare list of literatures in the relevant area.

CO3 - Compile the abstract from the literatures.

CO4 - Focus the search to a well-defined theme and title.

CO5 - Make and exhaustive report by compiling all the literatures that students surveyed.

CO6 - To prepare a research paper for publications in journal/conference proceedings.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
2	CO1	H	H				M						L	H	H	H
	CO2	H	H				M									H
	CO3	H	H	H	M								L	H		H
	CO4	H	H	H	M		L						M	M	H	H
	CO5	M	H	H	L		L									
	CO6	H			H										H	H
3	Category	EE														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18EEAU8P2	Project Work Phase - II	L	T	P	C
	Total Contact Hours – 18 Periods Per Week	0	0	18	9

	Prerequisite – Design and Fabrication with Analysis, Research article writing and Literature Survey
	Course Designed by- Department of Automobile Engineering
OBJECTIVE	
The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.	

The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline. Every project work shall have a Guide who is a member of the faculty of the University. Twelve periods per week shall be allotted in the Time table for this important activity and this time shall be utilized by the students to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present in periodical seminars or viva to review the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines. The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued from time to time.

Course Outcomes															
CO1 –comprehensive report															
CO2 – literature survey															
CO3 – problem statement, project work details															
CO4– project work details, estimation of cost and conclusions															
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	Cos /POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	PSO2	**PSO3**
2	CO1	H	H				M						L	H	H	H
	CO2	H	H				M							H	H	H
	CO3	H	H	H	M								L	H	H	H
	CO4	H	H	H	M		L						M	H	H	H
	CO5	M	H	H	L		L							H	H	H
	CO6	H				H								H	H	H
3	Category		EE													
4	Approval		47th Meeting of Academic Council held in Aug, 2018													

PROFESSIONAL ELECTIVE - I

U18PEAU011	**MANUFACTURING OF AUTOMOTIVE COMPONENTS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE:					
The main objective of this course is to impart knowledge maintenance records and schedule,					

maintenance, repair and overhauling of chassis drive line components, maintenance, repair and servicing of electrical systems, maintenance, repair and servicing of cooling, lubrication system, fuel system and body will be taught to the students.

MODULE 1 - POWDER METALLURGY **9**

Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.

MODULE 2 - FORMING PROCESS **9**

Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles. Extrusions: Basic Process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Hydro forming: Process, hydro forming of manifold and comparison with conventional methods - Hydro forming of tail Lamp housing. Stretch forming - Process, stretch forming of auto body panels - Super plastic alloys for auto body panels.

MODULE 3 - CASTING AND MACHINING **9**

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes and liners, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - flywheel - Honing of cylinder bores – copy turning and profile grinding machines.

MODULE 4 - GEAR MANUFACTURING **9**

Gear milling, Hobbing and shaping - Gear finishing and inspection.

MODULE 5 - RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS **9**

Powder injection molding - Shot peen hardening of gears - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminum composite brake rotors. Friction welding of dissimilar metal components.

TEXT BOOKS

1 Heldt.P.M., High Speed Combustion Engines, Oxford publishing co., New York, 2010.

REFERENCE BOOKS

1 Haslehurst.S.E., Manufacturing Technology, ELBS, London, 2010.
2 Rusinoff., Forging and forming of metals, D.B, Taraporevla Son & co Pvt ltd, Mumbai, 2005
3 Sabroff.A.M. & Others, Forging Materials & Processes, Reinhold Book Corporation, NewYork, 2008
4 Upton, Pressure Die Casting, Pergamon Press, 1985.
5 High Velocity Forming of metals, ASTME, Prentice Hall of India (P) Ltd., NewDelhi, 2010.

COURSE OUTCOMES (COs)	
CO1	The students should be able to familiarize on powder metallurgy technology
CO2	The students should be able to acquire the knowledge on forming process involved in various automotive components

CO3	The students should be able to obtain knowledge on casting & machining process of various automotive components
CO4	The students should be able to gain knowledge on various gears manufacturing process
CO5	The students should be able to expertise in recent trends of Automotive manufacturing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
2	CO1	H	H				M						L
	CO2	M	H				H						
	CO3	H	H	H	M					H		M	H
	CO4	H	H	H	M		L	H					M
	CO5	M	H	H	L		L						
3	Category	Professional Electives (PE)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18PEAU012	**AUTOMOTIVE POLLUTION AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Engines				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To acquire knowledge about Emission formation and controls in automobiles.					

MODULE 1 – INTRODUCTION **9**

Vehicle population assessment in International, National and Metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution. Emission Norms and Regularity Body – Challenges.

MODULE 2 – POLLUTANT FORMATION IN SI ENGINES **9**

Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines. NOx formation in SI engines. Effects of design and operating variables on emission formation, Flame Quenching- Kinetic Effect- Mixture Strength- crevice effect-oil film HC. Source and Control of evaporative emission. Two stroke engine pollution.

MODULE 3- POLLUTANT FORMATION IN CI ENGINES **9**

Pollutant formation in CI engines. Smoke and particulate Formation in CI engines-Composition of particulates, soot structure- stoichiometric considerations, nucleation, growth and oxidation. Formation of NO and NO2 in CI engines, NO formation in premixed and diffusion combustion periods. Formation of HC in CI engines, undermining and over mixing. Effect of engine variables effects of design and operating variables on CI engine emissions.

MODULE 4- CONTROL OF SI AND CI ENGINES EMISSIONS **9**

Design of engine, optimum selection of operating variables for control of emissions, Crankcase and evaporative emission control, Thermal and catalytic reactors, Elements of catalytic reactors, catalysts and substrates, Cold start HC control. EGR, Lean de-NOx catalysts, water injection, NOx traps and SCR. Diesel particulate filters (DPF), DPF regeneration, and Secondary air injection. Fuel modifications. Two stroke engine pollution control.

MODULE 5–MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST 9

Measurement of emissions, instrumentation for CO HC, NOx, PM. NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph and Smoke meters. Noise and Vibration Measurement – Harshness. Emission standards, driving cycles - USA, Japan, Euro and India. Test procedures - ECE, FTP Tests. SHED Test - chassis dynamometers, dilution tunnels - BS VI Norms

TEXT BOOKS

1 Paul Degobert - Automobiles and Pollution - SAE International ISBN-1-56091-563-3, 2015.

2 Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2013.

REFERENCE BOOKS

1 SAE Transactions- "Vehicle Emission"- 2012 (3 volumes).

2 Obert.E.F. - "Internal Combustion Engines"- 2015

3 Marco Nute- “Emissions from two stroke engines, SAE Publication - 2015.

COURSE OUTCOMES (COs)																
CO1	The students should be able familiarize the effect of various automotive emissions.															
CO2	The students should be able to gain Knowledge about the formation of various types of pollutants from SI and CI engines.															
CO3	The students should be able to acquire the significance of emission control techniques.															
CO4	The students should be able to familiarize the construction and working of emission measuring instruments.															
CO5	The students should be able to gain information on various emission standards and test procedures.															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	Cos /POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H		H
	CO2	M	H				H								H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	H	M		L	H					M	H	H	
	CO5	M	H	H	L		L									H
	CO6	H			H											H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU013	**AUTOMOTIVE SENSORS AND ITS APPLICATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Knowledge in electronics and engines				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To understand the importance and use of actuators, sensors and signal conditioning for automotive applications.					

MODULE 1 - INTRODUCTION **9**

Introduction to automotive sensors and instrumentation, Market perspective for sensors and instrumentation techniques. Sensor electronics and techniques. Overview of sensor measurements. Sensor linearization and characterization. Sensor classification. Signals and systems Sensor product selection guide.

MODULE 2 - SENSORS FOR ENGINES **9**

Sensors and interfacing- Pressure, position, flow, temperature, humidity, speed, acceleration, oxygen, torque, light, distance and level.

MODULE 3 – ACTUATORS **9**

Principles of actuation and control. DC motors, stepper motors. Relays and solenoids. Hydraulic and pneumatic actuators.

MODULE 4 - SENSORS FOR CHASSIS **9**

Sensors and interfacing techniques for Engine control, adaptive cruise control, braking control, traction control, steering and stability.

MODULE 5 - INTELLIGENT SENSORS **9**

Sensors for intelligent transport systems. Lighting, wipers, climate control and electronic displays. Sensors for occupant safety .The digital vehicle intelligent vehicle systems

TEXT BOOKS

1 E Q Doebelin, Measurement Systems, Application and Design, 4th edition, McGraw-Hill, 2012

2 William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes, 2016

REFERENCE BOOKS

1 Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2010.

COURSE OUTCOMES (COs)	
CO1	Familiarize on automotive instruments and sensor
CO2	Gain knowledge on the measurement of engine parameter by using sensor.
CO3	Acquire the concept on working of actuators.
CO4	Attain the knowledge on working of sensors.
CO5	Familiarize on application of intelligent sensors.
CO6	Familiarize on application of sensors for chassis

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos /POs	**A**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO 1**	**PSO 2**	**PSO 3**
2	CO1	H	H				M						L	H	H	H
	CO2	M	H				H								H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	H	M		L	H					M	M	H	
	CO5	M	H	H	L		L									H
	CO6	H			H										H	
3	Category	Professional Electives (PE)														

4	Approval	47th Meeting of Academic Council held in Aug, 2018

U18PEAU014	**PRODUCT DESIGN AND DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – New Product Development, Process Planning and Control				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: The objective of the course is to impart knowledge on the strategies, processes and methods used for new-product development.					

MODULE 1 - ENGINEERING DESIGN PROCESS **9**

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process –various phases of product development-planning for products –establishing markets- market segments- relevance of market research. Introduction to Automotive design, History of Automotive design, Car design brands & brand values and Brand history and Styling DNA and Case studies.

MODULE 2 - BENCH MARKING **9**

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies

MODULE 3 - CREATIVE DESIGN **9**

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods

MODULE 4 - PRODUCT DESIGN **9**

Decision making –decision theory –utility theory –decision trees –concept evaluation methods – Pugh concept selection method- weighted decision matrix –analytic hierarchy process –introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture

MODULE 5 - PRODUCT DEVELOPMENT **9**

Industrial design –Advance product Quality plan (APQP) - human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – Production part approval process(PPAP) –Feedback assessment and Corrective action- cost evaluation

TEXT BOOKS

1 George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

2 Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

3 Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, First print 2013, Butterworth-Heinemann, ISBN:978-0-7506-5044-1.

REFERENCE BOOKS

1 Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education,ISBN 9788177588217.

2 YousefHaik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141
3 Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

COURSE OUTCOMES (COs)															
CO1	Familiarize on the basics of engineering design process														
CO2	Acquire the concepts of benchmarking for quality improvement														
CO3	Gain knowledge on the systematic methods of creative designing														
CO4	Expertise in the various steps involved in automotive product design														
CO5	Expertise in the various processes involved in automotive product development														
CO6	Expertise in the various processes involved in industrial design														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	Cos /POs	**A**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H	H	H
	CO2	M	H				H							H	H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	H	M		L	H					M	H	H	H
	CO5	M	H	H	L		L							H		H
	CO6	H			H										H	
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

PROFESSIONAL ELECTIVE II

U18PEAU021	**AGILE MANUFACTURING (LEAN)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Process Planning and Control, New Product Development, Lean Manufacturing				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To acquire knowledge in understanding the functional and competition behavior in manufacturing industries, Lean concepts, inventory management systems. And acquiring knowledge in industrial automation technique for shop floor control.					

MODULE 1 AGILE MANUFACTURING 9

Definition, business need, conceptual frame work, characteristics, and generic features. Enterprise, Strategies, integration of organization, workforce and technology, reference models, examples.

MODULE 2 INTEGRATION OF PRODUCT /PROCESS DEVELOPMENT 9

Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.

MODULE 3 APPLICATION OF IT/IS CONCEPTS IN AGILE MANUFACTURING 9

Strategies, Management of complexities and information. Flow, approaches, applications of multimedia to improve agility in manufacturing, system concepts.

MODULE 4 AGILE SUPPLY CHAIN MANAGEMENT 9

Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners – comparison of concepts.

CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, examples.

MODULE 5 DESIGN OF SKILL & KNOWLEDGE 9

Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.

TEXTBOOKS

1. Gunasekaran A, "Agile Manufacturing, 21st Strategy Competitiveness Strategy", Elsevier Publications, 2001.
2. Montgomery J C and Levine L O, "The Transition to Agile Manufacturing – Staying Flexible for Competitive Advantage", ASQC Quality Press, Wisconsin, 1995.

REFRENCE BOOKS

1. Goldman S L, Nagal R N and Preiss K, "Agile Competitors and Virtual Organizations", Van Nostrand Reinhold, 1995.
2. Brian H Maskell, "Software and the Agile Manufacturer, Computer Systems and World Class Manufacturing, Productivity Press, 1993

COURSE OUTCOMES (COs)																
CO1	The manufacturing system and operation in terms of economic and technology.															
CO2	The manufacturing categories, material handling and manufacturing product															
CO3	The industrial automation levels and its functional requirement															
CO4	The importance of supply chain management and its vital role in making the system Lean															
CO5	The importance of Agility in the manufacturing industry and able to differentiate Lean Versus Mass Versus Agile manufacturing															
CO6	Ability to develop design skills and knowledge															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H		H
	CO2	M	H				H								H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	H	M		L	H					M	M		H
	CO5	M	H	H	L		L								H	M
	CO6	H			H									H		
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

	ALTERNATE FUELS AND ENERGY SYSTEMS	L	T	P	C
U18PEAU022	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Fuels and Lubricants, Fuels and Combustion, Engineering Chemistry				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To acquire the knowledge of alternate fuels, hybrid and electric vehicles					

MODULE 1 – INTRODUCTION **9**

Need for alternate fuel- Evolution- Availability and properties of alternate fuels, general use of alcohols, LPG, Hydrogen, Ammonia, CNG and LNG, Vegetable oils, water and biogas, Merits and demerits of various alternate fuels. Government norms and Subsidiary. Introduction to alternate energy sources. Like EV, Hybrid, Semi-Hybrid, Fuel cell, Nuclear Cars and Solar car,

MODULE 2 – ALCOHOLS **9**

Availability –Source- Types of Alcohols- Properties as engine fuel – Octane Number- Self Ignition Temperature- Calorific Value. Fuel and Engine Modification. Blending with diesel and gasoline- Dual Fuel Operation- Energy share Calculation. Performance in SI engine- Combustion characteristics in CI engines- Emission characteristics. Problems of using alcohols in diesel engine. DME, DEE properties- storage, Performance in SI & CI Engines.

MODULE – 3 NATURAL GAS, LPG, HYDROGEN AND BIOGAS **9**

Availability of CNG, properties, Difficulties of using gaseous fuel in IC engines – Modification required using in engines, Performance and emission characteristics of CNG using LPG in SI & CI engines, Performance and emission of LPG. Hydrogen; Storage and handling, properties – flame speed- flammability. Performance emission and Combustion behavior of hydrogen in CI engine - safety aspects and design of gaseous fuel induction system.

MODULE – 4 VEGETABLE OILS **9**

Design of engine, optimum selection of operating variables for control of emissions, Crankcase and evaporative emission control, Thermal and catalytic reactors, Elements of catalytic reactors, catalysts and substrates, Cold start HC control. EGR, Lean de-NOx catalysts, water injection, NOx traps and SCR. Diesel particulate filters (DPF), DPF regeneration, and Secondary air injection. Fuel modifications. Two stroke engine pollution control.

MODULE 5 – ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS **9**

Need of E-Vehicle. Layout of an electric vehicle, Advantage and limitations, Specifications, System components, Electronic control system, High energy and power density batteries,

battery design - Charging Station – Cost analysis. Hybrid vehicle – type- advantages and limitations. Fuel cell vehicles, Solar powered vehicles.

TEXT BOOKS

1 Richard.L.Bechfold - Alternative Fuels Guide Book - SAE International Warrendale - 2007.
2 Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2013.

REFERENCE BOOKS

1 MaheswarDayal - "Energy today & tomorrow" - I & B Horishr India - 2012.
2 Nagpal - "Power Plant Engineering" - Khanna Publishers - 2011.
3 Alcohols as motor fuels progress in technology" - Series No.19 - SAE Publication USE - 1980. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA.

COURSE OUTCOMES (COs)	
CO1	The students should be able to familiarize on various alternate fuels.
CO2	The students should be able to gain knowledge on the details of methanol and ethanol usage, storage, chemical structure.
CO3	The students should be able to acquire knowledge of natural gas, LPG, hydrogen and biogas.
CO4	The students should be able to attain the performance characteristics of various vegetable oils.
CO5	The students should be able to familiarize with electric and hybrid vehicles.
CO6	The students should be able to familiarize with solar cars

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H	H	
	CO2	M	H				H									H
	CO3	H	H	H	M					H		M	H	H	H	
	CO4	H	H	H	M		L	H					M	M		H
	CO5	M	H	H	L		L								H	
	CO6	H		H										H		H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU023	**SPECIAL TYPE OF VEHICLES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE: The main objective of this course is to impart knowledge earth moving and constructional equipments, power train concepts, sub systems of farm equipments, military and combat vehicles, special purpose vehicles for industrial applications will be taught to the students.

MODULE 1 EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS 11

Construction layout, capacity and applications of earthmovers like dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrappers, motor graders, and Water sprinklers etc. criteria for selection of prime mover fro dumpers and front end loaders based on vehicle performance characteristics.

MODULE 2 POWER TRAIN CONCEPTS 7

Engine – converter match curves. Hauling & cyclic type transmissions. Selection criteria for universal joints. Constructional details of steerable and drive axles of dumper.

MODULE 3 SUB SYSTEMS OF STV 11

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Tractor controls and the starting of the tractor engines – Basic notions and definition – Engine cycles – Operation of multicylinder engines – General engine design – Basic engine performance characteristics.

MODULE 4 SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATION 8

Cranes- Types, Constructional features, capacity and stability, Vibratory compactors, Material Handling vehicles- Forklift- Tippers-Others.

MODULE 5 FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 8

Ride and stability characteristics, power take off, special implementations. Special features and constructional details of tankers, gun carriers and transport vehicles. Classification of tractors – Main components of tractor – Safety rules.Working attachment of tractors – Farm equipment – Classification – Auxiliary equipment – Trailers and body tipping mechanism.

TEXTBOOKS:

1. Abrosimov. K. Bran berg.A. and Katayer.K.,"Road making Machinery", MIR Publishers, Moscow, 1971.
2. Wong.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York, 1987.
3. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.

REFERENCES:

1. Off the road wheeled and combined traction devices - Ashgate Publishing Co. Ltd. 1998.
2. Astokhov, Truck Cranes, MIR Publishers, Moscow.
3. Kolchin,A., and V.Demidov, Design of Automotive Engines for Tractor, MIR Publishers, 1972.

COURSE OUTCOMES (COs)	
CO1	The students should be able to Familiarize with the construction and working of various Earth moving equipment
CO2	The students should be able to Acquire the knowledge on construction and working of various constructional equipment
CO3	The students should be able to Gain knowledge on the construction and working of Farm equipment
CO4	The students should be able to Familiarize with the working of Industrial equipment
CO5	The students should be able to Develop the knowledge on working of Military equipment
CO6	The students should be able to Develop the knowledge on working of combat vehicles

Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	Cos /POs	**A**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H		H
	CO2	M	H				H								H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	H	M		L	H					M	M	H	
	CO5	M	H	H	L		L									H
	CO6	H				H									H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU024	**AUTOMOTIVE STANDARDS AND REGULATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Safety, Transport Management and Road Safety Engineering				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To familiarize the students about various automotive standards and regulations.					

MODULE 1 GENERAL AUTOMOTIVE STANDARDS AND REGULATIONS 9

Procedure For Type Approval And Certification Of Vehicles For Compliance To Central Motor Vehicles Rules - Speed Limitation Devices And Its Specifications - Arrangement Of Foot Controls Of Vehicles - Starting Grade-Ability - Method Of Measurement And Requirements - Protective Helmets For Motor Cycle Riders - Protective Helmets And Visors For Motorcycle Riders – Specification - Two Wheeled Vehicles – Location, Identification And Operation Of Controls, Tell-Tales And Indicators - Procedure For Type Approval And Establishing Conformity Of Production For Safety Critical Components - NCAP And BNVSAP Ratings, Requirements For School Buses.

MODULE 2 COLLISION SAFETY STANDARDS 9

Bumper Fitment On Vehicles – Test Methods - Safety Belt Assemblies, Safety Belt Anchorages – Specifications - Seats, Their Anchorages And Head Restraints Specifications, Survival Space For The Protection Of The Occupants - Requirements For Behavior Of Steering Mechanism Of A Vehicle In A Head-On Collision - Procedure For Determining The "H" Point And The Torso Angle, In Seating Positions Of Motor Vehicles - Requirements For The Protection Of The Occupants In The Event Of An Offset Frontal Collision - Approval Of Vehicles With Regards To The Protection Of The Occupants In The Event Of A Lateral Collision - Requirements For The Protection Of Pedestrian And Other Vulnerable Road Users In The Event Of A Collision With A Motor Vehicle - Requirements For The Protection Of Fuel System In The Event Of Rear Impact Of A Motor Vehicle.

MODULE 3 AUTOMOTIVE ELECTRICAL STANDARDS 9

Testing Procedure And Requirements For Headlamp Beam - Approval Of Front Position Lamps, Rear Position Lamps, Stop Lamps, Direction Indicators, Rear Registration Plate Illuminating Devices And Reversing Lamp - Provisions Concerning The Approval Of Headlamps Equipped With Gas Discharge Light Sources - Provisions Concerning The Approval Of Light Emitting Diode (LED) Light Sources For Use In Approved Lamp Units -

Lighting, Signaling & Indicating Systems On Motor Vehicles - Performance Requirements Of Lighting And Light-Signaling Devices - Testing Standards For Wind Screen Wiping System - Horn Installation Requirement - Electronic Stability Control Systems.

MODULE 4 ELECTRIC AND HYBRID VEHICLE STANDARDS 9

Battery Operated Vehicles – Requirements For Construction And Functional Safety - Measurement Of Electrical Energy Consumption - Method Of Measuring The Range - Measurement Of Net Power And The Maximum 30 Minute Power And Speed - Electric Power Train - Requirements For Construction And Functional Safety - CMVR Type Approval For Hybrid Electric Vehicles, CMVR Type Approval Of Vehicles Retrofitted With Hybrid ElectricSystem.

MODULE 5 CNG, LPG VEHICLES AND ENGINE EMISSION STANDARDS 9

Safety And Procedural Requirements For Type Approval Of CNG Operated Vehicles and LPG Operated Vehicles - Code Of Practice For Use Of LPG Fuel In Internal Combustion Engine To Power 4 Wheeled Vehicles, 2 & 3 Wheeled Vehicles, Bharath And Euro Emission Norms.

COURSE OUTCOMES (COs)															
CO1	Gain knowledge about basic automobile standards and regulations														
CO2	Gain knowledge about standards for safety during collision.														
CO3	Understand the various standards used for automotive electrical systems.														
CO4	Gain knowledge about the regulations used for hybrid and electric vehicles.														
CO5	Gain knowledge about the regulations used for gaseous fuel vehicles.														
CO6	Gain knowledge about the engine emission standards														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				M						L	H		H
	CO2	M	H				H								H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	H	M		L	H					M	M		H
	CO5	M	H	H	L		L								H	
	CO6	H		H			H							H		H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

PROFESSIONAL ELECTIVE III

U18PEAU031	**FLEXIBLE MANUFACTURING SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE: At the end of this course the student should be able to understand

- Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

MODULE 1 PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

MODULE 2 COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

MODULE 3 FMS SIMULATION AND DATA BASE 9

Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

MODULE 4 GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9

Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification.

MODULE 5 APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

TEXTBOOKS

1. Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc.,1991.

REFERENCEBOOKS

1. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd.,New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 1992.

COURSE OUTCOMES (COs)															
CO1	Gain knowledge about Scheduling and Planning in FMS														
CO2	Gain knowledge about Computer Control System with its function in FMS														
CO3	Understand the FMS simulation and Database.														
CO4	Gain knowledge about the Group technology and Justification of FMS														
CO5	Gain knowledge on applications of FMS														
CO6	Gain knowledge on applications of FMS in future														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**

2	CO1	H	H				M						L	H	H	
	CO2	H	H				H								H	H
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	H	M		L	M					M	M	H	H
	CO5	M	H	H	L		L								H	H
	CO6		H		H										H	
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU032	COMBUSTION ENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Thermodynamics and Thermal Engineering				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To understand and analyze the combustion with emphasis on engineering applications.					

MODULE 1 CHEMICAL REACTIONS **9**

Fuels and combustion, Theoretical and actual combustion processes, Enthalpy of formation and enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature, Entropy change of reacting systems, Second law analysis of reacting systems, problems

MODULE 2 COMBUSTION OF GASEOUS AND VAPORIZED FUELS **9**

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation

MODULE 3 COMBUSTION OF LIQUID FUELS **9**

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays

MODULE 4 COMBUSTION OF SOLID FUELS **9**

Drying of solid fuels, devolatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

MODULE 5 FLUIDIZED BED COMBUSTION **9**

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, circulating fluidized beds, pressurized fluidized bed combustion, problems.

TEXTBOOK

1. Yunus.A.Cengel- A textbook of Thermodynamics

REFERENCE BOOKS

1. Gary.L.Borman, Combustion Engineering-McGraw Hill international Edition,1998
2. Roger.A.Strehlow-Combustion fundamentals- McGraw Hill international Edition,1989.

COURSE OUTCOMES (COs)	
CO1	Understand various types of fuels and its properties

CO2	Understand the concept of gaseous fuels															
CO3	Will able to differentiate gaseous and liquid fuels															
CO4	Will understand the concept of solid fuels															
CO5	Student understands the fundamentals in combustion of fuels.															
CO6	Student understands the fundamentals in FBD.															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H						L	H		H
	CO2	H	H				H								H	
	CO3	H	H	H	H					M		M	H	H		H
	CO4	H	H	H	M		L	M					M	M	H	
	CO5	M	H	H	L		L									H
	CO6	H				M								H	H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU033	**AUTOMOTIVE AIR-CONDITIONING SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: At the end of the course, the students will be able to understand the components of the automotive air-conditioning and their functions and the latest developments in this field.					

MODULE 1 AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS 9

Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problems

MODULE 2 AUTOMOTIVE COOLING AND HEATING SYSTEM 9

Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation

Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system

MODULE 3 AIR-CONDITIONING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS 9

Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining driveability- Preventing Overheating

Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls

Containers – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

MODULE 4 AUTOMATIC TEMPERATURE CONTROL 9

Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system

MODULE 5 SYSTEM SERVICING AND TESTING 9

Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system- Automatic temperature Control system diagnosis and service

TEXT BOOKS:

1. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual, Pearson Prentice Hall, 2004
2. William H Crouse and Donald L Anglin, "Automotive Air conditioning", McGraw Hill Inc., 1990.

REFERENCES:

1. Goings,L.F., "Automotive Air Conditioning", American Technical services, 1974.
2. Mitchell Information Services, Inc., "Mitchell Automatic Heating and Air Conditioning Systems", Prentice Hall Inc., 1989.
3. McDonald,K.L., "Automotive Air Conditioning", Theodore Audel series, 1978.
4. Paul Weisler, "Automotive Air Conditioing", Reston Publishing Co. Inc., 1990.

COURSE OUTCOMES (COs)																
CO1	To Understand the basic concepts and fundamentals of Automotive Air-conditioning. .Systems															
CO2	To Know about Automotive Cooling and Heating System.															
CO3	To Understand air-conditioning controls delivery system and refrigerants.															
CO4	To Gain Knowledge about automatic temperature control.															
CO5	To Know and to understand system servicing And testing.															
CO6	To learn about diagonistics of air-conditioning system															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H						L	H		H
	CO2	H	H				H								M	H
	CO3	H	H	H	M					H		M	H	H	H	
	CO4	H	H	M	M		L	M					M	M	H	H
	CO5	M	H	H	L		L								M	
	CO6		H		M											H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU034	**AUTOMOTIVE STYLING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Chassis, Vehicle Design, Automotive Body Building Technology and Vehicle Body Engineering				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To learn about how to design and make styling of automotive bodies using					

software.

BODY AND CHASSIS SYSTEMS **9**

Complete Body-In-White, Floor Pans, Underbody Assemblies, Door/Hood/Deck Assemblies, Roof Panels ,Fender/Quarter Panels , Tailgate/Lift gate Assemblies ,A, B, C and D Pillars , Bumper Beams, Door Intrusion Systems, Oil Strainers, Heat Shields, Cross member Assemblies, Radiator Supports Shock Towers, Engine Cradles, Front and Rear Sub-Frame Assemblies, Front and Rear Suspension Modules, Control Arms, Frame Rails, Full Frame Assemblies

EXTERIOR SYSTEMS **9**

Front and Rear Fascias, Energy Management Systems , Greenhouse & Sealing Systems-Backlit Moldings , Belt and Windshield Mouldings,Decklid and Pillar Appliqués, Door Surround Moldings Roof Drip Mouldings,Cowl Screens ,Window Surround Modules, Door Seals ,Inner & Outer Belt Seals Glass Run Channels, Side Door, Pop-Out Window, Lift gate Seals, Complete Convertible Seating System-Backlights and Quarter Windows, Exterior Trim- Body Side Moldings and Claddings , Wheel Opening Moldings, Rocker Panels, Stone Guards/Mud Flaps, Spoilers and Grilles, Vehicle Enhancement Packages-Ground Effects, Roof Racks, Running Boards, Plastic Body Panels-Vertical Body Panels, Front and Truck side Fenders, Door Panels, Quarter Panels

INTERIOR SYSTEMS **9**

Door Modules-Complete Door Modules, Sealed Modules, Hardware Trim Modules, Integrated Trim Modules, Structural Plastic Modules, Lift gate and Tailgate Modules, Mid-Door Modules Window Systems- Single and Dual Rail Systems, Cable and Drum Systems ,Arm and Sector Systems ,Quarter Systems, Rear Window Systems, Integrated Electronics, Power Closer System-Power Sliding Doors ,Power Lift gates, Integrated Electronics, Obstacle Detection, Driver Controls- Adjustable Pedals, Fixed Pedals, Park Brakes

LATCHING SYSTEMS AND HANDLE ASSEMBLIES **9**

Side Door Latches, Sliding Door Latches, Lift gate Latches, Hood Latches, Tailgate, Deck lid Latches, Actuator Assemblies, Inside Handles, Outside Handles

SEATING AND HARDWARE SYSTEMS **9**

In-Vehicle Stowable Seating, Stow-in-Floor, Stow-to-Floor, Other Specialty Options, Modular Seat Assemblies, Integrated Child Safety Seats , Integrated Occupant Safety Restraints, Trim Covers, Specialty Mechanisms for In-Vehicle Seat , Stowage , Stow-in-Floor, Stow-to-Floor, Other Specialty Options , Manual Adjusters, Seat Height Adjusters, EZ Entry Mechanisms, Fold & Tumble TM Mechanisms Manual Recliners, Fold Flat Mechanisms, Specialty Latches, Spring Suspension Systems , Risers , Power Recliners, Power Adjusters

TEXT BOOKS:

1. Herb Adams, "Chassis Engineering", HP Books-Penguin Publishers, 1993.
2. Martin W. Stockel &Martin T. Stockel, “Auto mechanics fundamentals", Good heart-Wilcox Co., 1982.
3. William Crouse and Donald Anglin, “Automotive Mechanics- SIE", Tata McGraw-Hill Education, 1960

REFERENCES:

1. Penny Sparke, "A Century of Car Design", Barron’s Educational Series, 2002.

2. Tony Lewin and Ryan Borroff, “How to Design Cars like a Pro", Motor books, 2010.
3. James E. Duffy, “Modern Automotive Technology", 9th Edition, Goodheart-Willcox Publisher, 2017.

COURSE OUTCOMES (COs)																
CO1	To Understand the basic concepts and fundamentals of Automotive Chassis and Body Design															
CO2	To Understand the basic concepts and fundamentals of Exterior Systems in Automobile															
CO3	To Understand the basic concepts and fundamentals of Interior Systems in Automobile															
CO4	To Gain Knowledge about Latching System and Door Handle Assemblies															
CO5	To Know and to understand Seating system and its Hardware technology															
CO6	To Know and to understand latching system and its Hardware technology															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/Pos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H		H		H				H		L	H		H
	CO2	H	H		M		H								H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	M					M	M		
	CO5	M	H	H	L		L				L				H	H
	CO6	H		H											H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

PROFESSIONAL ELECTIVE – IV

U18PEAU041	**Artificial Intelligence**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To learn about basic representation knowledge of AI					

MODULE –1: INTRODUCTION TO Al AND PRODUCTION SYSTEMS 9

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms

MODULE –2: REPRESENTATION OF KNOWLEDGE 9

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

MODULE – 3: KNOWLEDGE INFERENCE **9**

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory

MODULE – 4: PLANNING AND MACHINE LEARNING **9**

Basic plan generation systems - Strips -Advanced plan generation systems – K strips – Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

MODULE –5: EXPERT SYSTEMS **9**

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

TEXT BOOKS

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2018.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2 nd Edition, Pearson Education 2010.

REFERENCE BOOKS

Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013

COURSE OUTCOMES (COs)																
CO1	Study the concepts of Artificial Intelligence.															
CO2	Learn the methods of solving problems using Artificial Intelligence															
CO3	Introduce the concepts of Expert Systems and machine learning															
CO4	Identify problems that are amenable to solution by AI methods															
CO5	Formalize a given problem in the language/framework of different AI methods.															
CO6	Formalize typical expert systems - MYCIN, DART, XOON, Expert systems shells.															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**B**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H		H		H				H		L	H		H
	CO2	H	H		M		H								H	H
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	M					M	M	H	H
	CO5	M	H	H	L		L				L					H
	CO6	H			H										H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU042	**FUELS AND LUBRICANTS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC Engines, Automotive Fuels				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE: To understand the properties of fuels and lubricants for the design and operation of the I.C engines.

MODULE 1 MANUFACTURE OF FUELS AND LUBRICANTS 9

Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

MODULE 2 THEORY OF LUBRICATION 9

Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

MODULE 3 LUBRICANTS 9

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease.

MODULE 4 PROPERTIES AND TESTING OF FUELS 9

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc.

MODULE 5 COMBUSTION & FUEL RATING 9

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives – specifications of fuels.

TEXT BOOKS:

1. Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. Mathur. M.L., Sharma. R.P. “A course in internal combustion engines”, Dhanpatrai publication, 2003.
3. Obert. E.F “Internal Combustion Engineering and Air Pollution”, International book Co., 1988.

REFERENCES:

1. Brame, J.S.S. and King, J.G. – "Fuels Solids, Liquids, Gaseous". Edward Arnold, 1961
2. Francis, W, "Fuels and Fuel Technology", Vol. I & II, Pergamon, 1965
3. Hobson, G.D. & Pohl.W "Modern Petroleum Technology", 1974
4. Lansdown. A.R., Lubrication, "A practical guide to lubricant selection", Pergamon press, 1982.
5. Raymond. C. Gunther, "Lubrication", Chilton Book Co., 1971

COURSE OUTCOMES (COs)	
CO1	The Students should know about manufacture of fuels and lubricants
CO2	To Know and Understand about theory of lubrication
CO3	The Students should know about lubricants
CO4	The Students should know about properties and testing of fuels
CO5	The Students should know about combustion & fuel rating
CO6	The Students should know about additive mechanism

Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H						L	H		H
	CO2	H	H				H								H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	M					M	M	H	
	CO5	M	H	H	L		L								H	H
	CO6	H			M										H	H
3	Category		Professional Electives (PE)													
4	Approval		47^{th} Meeting of Academic Council held in Aug, 2018													

	TWO AND THREE WHEELERS	**L**	**T**	**P**	**C**
U18PEAU043	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Engines and Auxiliaries				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: The aim of this course is to make the students to know and understand the constructional details operating characteristics and vehicle design aspects					

MODULE 1 THE POWER UNIT **9**

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams. Scavenging process.

MODULE 2 FUEL AND IGNITION SYSTEMS **9**

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, Starting system - Kick starter system – Self-starter system. Recent technologies.

MODULE 3 CHASSIS AND SUB-SYSTEMS **9**

Main frame for two and three wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its and various gear controls in two wheelers. Front and rear suspension systems. Shock absorbers. Panel meters and controls on handle bar, Freewheeling devices

MODULE 4 BRAKES AND WHEELS **8**

Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links lay-outs. Brake actuation mechanism. Spoked wheel, cast wheel, Disc wheel & its merits and demerits. Tyres and tubes Construction & its Types. Steering geometry.

MODULE 5 TWO & THREE WHEELERS – CASE STUDY **10**

Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer. Servicing and maintenance. Recent developments.

TEXT BOOK:

1. Irving,P.E.," Motor cycle Engineering", Temple Press Book, London, 1992.

REFERENCES:

1. Bryaut, R.V., Vespa "Maintenance and Repair series".
2. Marshall Cavendish, Encyclopedia of Motor cycling, 20 volumes, New York and London, 1989.
3. Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai,2009
4. Raymond Broad Lambretta – "A practical guide to maintenance and repair", 1987.
5. The Cycle Motor Manual, Temple Press Ltd., London, 1990.

COURSE OUTCOMES (COs)																
CO1	To Know and to Understand the Power unit of Two and Four stroke engines															
CO2	To Know about fuel and ignition systems															
CO3	To Know and understand about chassis and sub-systems															
CO4	To Understand the systems of brakes and wheels															
CO5	To Know and to evolve two & three wheelers with their case study															
CO6	To Know and understand steering geometry															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			M			L	H	H	H
	CO2	M	H				H				M				H	H
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	M	M		L	M					M	M		H
	CO5	M	H	H	L		L			L					H	H
	CO6	H		M											H	
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU044	**AUTOMOTIVE INSTRUMENTATION AND EMBEDDED SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Electrical and Electronics, Electronics and Instrumentation				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To attain the knowledge of instrumentation and embedded system					

MODULE-1 MEASUREMENT CHARACTERSTICS 9

Instrument Classification, Characteristics of Instruments - Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments

MODULE -2 AUTOMOTIVE INSTRUMENTATION 9

Modern automotive instrumentation - computerized instrumentation system, multiplexing, sampling and advantages - Measurements - fuel quality, coolant temperature, oil pressure vehicles speed, Display devices - LED, LCD, VFD, CRT and types, CAN network, the glass cockpit and information system. On-board diagnostics - fault code displays. Off board diagnostics - engine data display, expert system occupant protection system - Airbag deployment system security and warning systems.

MODULE – 3 MEASUREMENT ANALYSIS 9

Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

MODULE – 4 INTRODUCTION TO EMBEDDED SYSTEM 9

Introduction to functional building blocks of embedded systems - Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories –Devices & buses for devices network - serial communication using I2C, CAN, USB buses – parallel communication using ISA, PCI - device drivers in a system - Serial port & parallel port.

MODULE -5 REAL TIME OPERATING SYSTEM (RTOS) 9

Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS - Interrupt handling, task scheduling; embedded system design issues in system development process - Action plan, use of target system, emulator, use of software tools

TEXT BOOKS

1 WilliamB.Riddens - Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, Woburn- 2015

2 Rajkamal, 'Embedded System - Architecture, Programming, Design', Tata McGraw Hill, 2013.

3 Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2014.

4 Holman, J.P., Experimental methods for engineers, McGraw-Hill, 2013

5 Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, TataMcGraw

COURSE OUTCOMES (COs)																
CO1	Familiarize on measurement characteristics															
CO2	Acquire the knowledge on working of automotive instruments															
CO3	Gain knowledge on measurement analysis															
CO4	Develop the knowledge on embedded systems															
CO5	Attain the knowledge on real time operating system(RTOS)															
CO6	Attain the knowledge on airbag development system															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H	H	H
	CO2	M	H				H				M				H	H
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	M	M		L	H					M	M		H
	CO5	M	H	H	H		L			L					H	
	CO6	H			H										H	H
3	Category	Professional Electives (PE)														

4	Approval	47th Meeting of Academic Council held in Aug, 2018

PROFESSIONAL ELECTIVE – V

	ROBOTICS FOR AUTOMOBILE ENGINEERS	L	T	P	C
U18PEAU051	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Mechatronics, Robot Engineering, Applied Hydraulic and Pneumatics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE: The main objective of this course is to impart knowledge in introduction to robot application, end effectors and sensors, robot cell design, robot programming, industrial applications will be taught to the students.

MODULE 1 INTRODUCTION TO ROBOT APPLICATION 9

Basic concepts - Robot anatomy - Manipulators - kinematics: Forward and inverse kinematics - Precision movement, robot specifications and Work volume, Types of Robot drives - Basic robot motions - Point to point control, continuous path control. Robot control - unit control system concept - servo and non-servo control of robot joints, adaptive and optimal control.

MODULE 2 END EFFECTORS AND SENSORS 9

End effectors - classification - mechanical, magnetic, vacuum and adhesive gripper - gripper force analysis and design. Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors - Proximity and range sensors - acoustic sensors Robot vision systems - Sensing and digitizing - Image processing and analysis.

MODULE 3 ROBOT CELL DESIGN 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis.

MODULE 4 ROBOT PROGRAMMING 9

Robot language classification - programming methods - off and on line programming - Lead through method - Teach pendent method - VAL systems and language, simple program.

MODULE 5 INDUSTRIAL APPLICATIONS 9

Application of robots - Material handling - Machine loading and unloading, Assembly, Inspection, Welding, Spray painting, Mobile robot, Microbots-Recent developments in robotics-safety considerations.

TEXT BOOKS:

1. Deb S. R, "Robotics technology and flexible automation", Tata McGraw Hill publishingcompany limited, New Delhi, 2010
2. Mikell P. Groover, "Industrial Robotics Technology Programming and Applications", McGraw Hill Co., Singapore, 2008.

REFERENCES

1. Klafter, R. D, Chmielewski, T. A. and Noggins, "Robot Engineering: An Integrated Approach", Prentice Hall of India Pvt. Ltd., New Delhi, 2011
2. Fu, K. S., Gonzalez, R. C., & Lee, C.S.G., "Robotics control, sensing, vision and Intelligence",McGraw Hill Book Co., Singapore, Digitized 2007
3. Craig, J. J., "Introduction to Robotics mechanics and control", AddisonWesley, London, 2008.

COURSE OUTCOMES (COs)																
CO1	To learn the detailed study of introduction to robot application															
CO2	To learn the detailed study of end effectors and sensors															
CO3	To learn the detailed study of robot cell design															
CO4	To learn the detailed study of robot programming															
CO5	To learn the detailed study of industrial applications (welding techniques)															
CO6	To learn the detailed study of industrial applications (machine loading & unloading)															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**G**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H		H
	CO2	M	H				H				M				H	H
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	H					M	M		
	CO5	M	H	H	H		L			L					H	
	CO6	H		M											H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU052	SIMULATION OF IC ENGINES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Automotive Engines				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: The main objective of this course is to impart knowledge in introduction, adiabatic flame temperature, spark ignition engines, si engine simulation with adiabatic combustion, si engine simulation with gas exchange process will be taught to the students.					

MODULE 1 INTRODUCTION 8

Simulation, advantages of computer simulation, step – by – step approach, reactive processes, heat reaction, measurement of URP, measurement of HRP.

MODULE 2 ADIABATIC FLAME TEMPERATURE 8

Introduction, complete combustion C/H/N/O/ systems, constant – volume adiabatic combustion, constant – pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.

MODULE 3 SPARK IGNITION ENGINES 9

Introduction, Basic details and nomenclature, cylinder pressure indicator diagram, indicated power, brake power, SI Engine simulation with air as working medium, deviation between actual and ideal cycle.

MODULE 4 SI ENGINE SIMULATION WITH ADIABATIC COMBUSTION 10

Introduction, Engine details, temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation, SI Engines simulation with progressive combustion.

MODULE 5 SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS 10

Introduction, gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance, simulation of two stroke SI Engine.

TEXTBOOK:

1. Ganesan,V., Computer Simulation of spark ignition engine process, Universities Press (I) Ltd., Hyderabad, 1996.

REFERENCES:

1. Ramoss,A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.
2. Ashley Campbel, Thermodynamics analysis of combustion engines, John Wiley & Sons, New York, 1986.

COURSE OUTCOMES (COs)																
CO1	To learn the detailed study of introduction															
CO2	To learn the detailed study of adiabatic flame temperature															
CO3	To learn the detailed study of spark ignition engines															
CO4	To learn the detailed study of SI engine simulation with adiabatic combustion															
CO5	To learn the detailed study of SI engine simulation with gas exchange process															
CO6	To learn the detailed study of SI engine simulation of 2-stroke engine															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H	H	
	CO2	M	H				H				M					H
	CO3	H	H	H	M					H		M	H	H	H	
	CO4	H	H	M	M		L	H					M	H		H
	CO5	M	H	H	H		L			L						H
	CO6	M			H									H		H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU053	**TYRE TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Materials, Rubber Technology, Modern Manufacturing Process				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: The main objective of this course is to impart knowledge infabric preparation, calendaring, thread extrusion and bead construction, tyre building, green tyre preparation & curing will be taught to the students.					

MODULE 1 FABRIC PREPARATION 9

Fabrics of the Tyre Industry: Cotton, Rayon, Nylon & steel cords – manufacture, construction – styles and presentations. Bonding methods – Fabric bonding necessities of stronger fabrics leading to bonding methods developments. Wet & dry bonding systems – dip and hot stretch process for Nylon. REL-VP latex systems – and parameters for dip & hot stretch process for

Nylon. Modified surface treatment needed for polyesters & glass fabric - Metal coating for steel cord. Recent developments in Radical Tyre fabrics – Aromatic Nylon (Kevlar) and other special fabric reinforcement systems and their use - Testing of dipped fabrics 'U', 'H' and other tests. Dip pick up and the relation to adhesion etc.

MODULE 2 CALENDERING 9

Calendering process: 3 and 4 roll calenders. Skimming & frictioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calenders. Topping process on calendar - Limitation of 3 roll calenders and advantages of 4 roll calenders-process control aspects – economics - Relation between ends per inch and calendering process. Inner, outer and breaker fabrics. Compound fabric ratios and compound design consideration for different styles of fabrics - Defects of calendered fabrics and their remedies. Parameters for scrap control in fabric processes in the tyre industry requirement of total quality control involving fabric supplier's dipping, calendering and bias cutting operations. Economics of fabric usage.

MODULE 3 THREAD EXTRUSION AND BEAD CONSTRUCTION 9

Basic concepts of Extrusion. Die swell & shrinkage phenomenon – effect of compounding parameters on these phenomenon. Die design and theoretical calculation of tread weight. Effect of viscosity & temperature on extrusion. Dimensions and weight control extusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile – critical dimensions. Duel extruder – Cap & base concept relation to tyre wear parameters like tread wear heat buildup etc. Cross head extruder wire coating process - Bias cutting and pocket making: Bias angle specification and the significance Horizontal and vertical laying of coated wore. Apex preparation on extruder and profile calender Bead wrapping and flipping operations. Single and double bead concept and preliminary calculation of bead safety factors. Width and angle adjustments splicing and identification. Bias plies pocket 3-3-2 4-4-2 ply constructions Defects of pockets wrong identification over splicing wrinkles, parallel plies etc.

MODULE 4 TYRE BUILDING 9

Tyre building inputs: Inner liners, plies, beads, tread, side wall and gum strips – their inspection Drum inspection for drumset, drum circumference Significance of parameters for tyre building. Size making on finished tyre and the relation to building specifications. Tyre building specifications sequence of building. Intermitant consolidation use of various cements and gum strips. Importance of the state of the Art Technology. Appraisal of Tyre building as most crucial operation correlation of some of the cured tyre & service returned tyres to the lack of building skill. Green tyre inspection procedures weight tolerancetechno-commercial importance of green tyre weight. Green tyre storage considerations.

MODULE 5 GREEN TYRE PREPARATION & CURING 9

Internal and External painting – Awling – Bagging in case of Air bag cure Bag-omatic and Air bag curing – mold lubrication- Bladder assembly bead curing rings – Dimension criticality Services to the Bag-o-matic presses Curing cycle – shaping – HPS, and hot water circulation. Dome steam cold water & vacuum cycles. Determination of optimum cure of tyres by thermocouple built tyres. Economics of curing post cure inflation of Nylon tyres cured tyre inspection. Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fastwear, poor retreading Bead/casing failures. Hot and cold process retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

TEXT BOOK:

1. Tom French, Tyre technology, The University of Michigan, 1989.

REFERENCES:

1. Blow. C. M, Rubber Technology and Manufacture, Butterworth- Heinemann, London, 1982.
2. Maurice Morton, "Rubber Technology", Springer, 3rd edition, 1987.
3. Claude Hepburn, "Rubber Technology and Manufacture", Third Edition,2005
4. Kovac. F. J, "Tyre Technology", Good Year Tire & Rubber Company, 1973.

COURSE OUTCOMES (COs)															
CO1	To learn the detailed study of fabric preparation														
CO2	To learn the detailed study of calendering														
CO3	To learn the detailed study of thread extrusion and bead construction														
CO4	To learn the detailed study of tyre building														
CO5	To learn the detailed study of green tyre preparation & curing														
CO6	To learn the detailed study of green tyre preparation & curing														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H		H
	CO2	M	H				H				M				H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	H					M	M	H	
	CO5	M	H	H	H		L			L					H	H
	CO6	M			M										H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU054	**AUTOMOTIVE SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Chassis Design, Automotive Aerodynamics				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: At the end, the students will have good exposure to automotive safety aspects including the understanding of the various safety equipment's.					

MODULE 1 INTRODUCTION **9**

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

MODULE 2 SAFETY CONCEPTS **9**

Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

MODULE 3 SAFETY EQUIPMENTS **9**

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

MODULE 4 COLLISION WARNING AND AVOIDANCE **9**

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

MODULE 5 COMFORT AND CONVENIENCE SYSTEM **9**

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

TEXT BOOKS

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.

REFERENCES:

1. Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.

COURSE OUTCOMES (COs)																
CO1	To learn the detailed study of introduction															
CO2	To learn the detailed study of safety concepts															
CO3	To learn the detailed study of safety equipment's															
CO4	To learn the detailed study of collision warning and avoidance															
CO5	To learn the detailed study of comfort system															
CO6	To learn the detailed study of convenience system															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H		H
	CO2	M	H				H				M				H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		L			L					H	H
	CO6	H		M			M								H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

PROFESSIONAL ELECTIVE – VI

U18PEAU061	**TRANSPORT MANAGEMENT AND MOTOR INDUSTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Industrial Engineering and Management, Total Quality Management, Road Safety Engineering				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: The students are able to manage a transport fleet and their related activities					

for minimizing operational cost.

MODULE 1 INTRODUCTION **9**

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE 2 TRANSPORT SYSTEMS **9**

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE 3 SCHEDULING AND FARE STRUCTURE **9**

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

MODULE 4 MOTOR VEHICLE ACT **9**

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE 5 MAINTENANCE **9**

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCE:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date

COURSE OUTCOMES (COs)	
CO1	To learn the detailed study of introduction on transportation modes
CO2	To learn the detailed study of transport organization and development
CO3	To learn the detailed study of planning for new transport organization
CO4	To learn and to understand the Motor Vehicle Act
CO5	To learn the detailed study of accident & prevention
CO6	To learn the detailed study of bus depot layout

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	M		H
	CO2	M	H				H				M				H	
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	H					M	M	M	H
	CO5	M	H	H	H		L			L					H	

	CO6	M				M									H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU062	**NOISE, VIBRATION AND HARSHNESS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Pollution and Its Control, Environmental Science , Mechanical Vibrations & Vehicle Dynamics				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

- knowledge in basic of vibration and noise
- Understanding the effect of noise an human comfort and environment
- Knowing the methods of vibration and noise measurement.

MODULE 1 FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION 8

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

MODULE 2 EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE 7

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

MODULE 3 TRANSPORTATION NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL 10

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

MODULE 4 INTERIOR TRANSPORTATION NOISE AND VIBRATION SOURCES - PREDICTION AND CONTROL 10

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control

MODULE 5 NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT, SIGNAL PROCESSING, AND MEASURING TECHNIQUES 10

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for

Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

TEXT BOOKS:

1. Clarence W. de Silva , "Vibration Monitoring, Testing, and Instrumentation ",CRC Press, 2007
2. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice "Spon Press, London, 2009

REFERENCES:

1. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill , New Delhi, 2010
2. Colin H Hansen "Understanding Active Noise Cancellation" , Spon Press , London 2003
3. Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles ", Elsevier Butterworth-Heinemann, Burlington, 2004

COURSE OUTCOMES (COs)																
CO1	To learn the detailed study of basics of vibration analysis															
CO2	To learn the detailed study of vibration control techniques															
CO3	To learn the detailed study of noise fundamentals															
CO4	To learn the detailed study of NVH measurements															
CO5	To learn the detailed study of automotive noise sources and control techniques															
CO6	To learn the detailed study of automotive noise measuring techniques															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/ Pos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO 1**	**PSO 2**	**PSO 3**
2	CO1	H	H				H			H			L	L	H	H
	CO2	M	H				H				M				M	H
	CO3	H	H	H	M					H		M	H	H		H
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		L			L						H
	CO6	H					M								H	
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU063	**ADVANCED THEORY OF IC ENGINES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Automotive Petrol and Diesel Engines, IC Engine Testing				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To familiarize the knowledge of advanced engines.					

MODULE 1 - COMBUSTION PRINCIPLES **6**

Combustion – Combustion equations, heat of combustion – chemical equilibrium and Dissociation-Theories of Combustion - Flammability Limits - Reaction rates - Laminar and Turbulent Flame Propagation in Engines. Introduction to spray formation and characterization.

Suggested Reading: Fuel properties, Adiabatic Flame temperature

MODULE 2 - COMBUSTION IN SI ENGINES 9

Stages of combustion, normal and abnormal combustion, knocking, variables affecting knock,

Features and design consideration of combustion chambers. Flame structure and speed, cyclic variations, Lean burn combustion, Stratified charge combustion systems. Heat release correlations.

Suggested Reading: Fuel qualities affecting knocking, Types of combustion chambers, p-theta graphs, HRR curves, Cumulative Heat release, ignition delay, combustion duration.

MODULE 3 - COMBUSTION IN CI ENGINES 9

Stages of combustion, vaporisation of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion, Direct and indirect injection systems.

Suggested Reading: K-Jetronic, KE-Jetronic, Motronic Systems

MODULE 4 - ADVANCES IN IC ENGINES 9

Surface ignition concept and multi fuel engines, Lean Burn Engines, LHR engines, Stratified charge Engines, HCCI engines - Performance and emission characteristics, Merits and demerits. Use of Nano Technology in IC engines.

Suggested Reading: Fuel qualities affecting knocking, Types of combustion chambers, p-theta graphs, HRR curves, Cumulative Heat release, ignition delay, combustion duration.

MODULE 5 - IGNITION SYSTEMS AND ENGINE MAPPING 12

Computer control of SI & CI engines for better performance and low emissions, Closed loop control of engine parameters of fuel injection and ignition.

Suggested Reading: Electronic ignition systems, ECU for controlling emissions, Ignition and Injection timing calculations.

TEXT BOOKS

1 John B. Haywood, "Internal Combustion Engine Fundamentals", McGraw-Hill Automotive Technology series.

REFERENCE BOOKS

1 R.B. Mathur and R.P.Sharma, Internal Combustion Engines, Dhanapat Rai Publications,2010.

2 Richard Stone - "Introduction to IC Engines" – 4th edition – Macmilan.

3 B.P. Pundir Engine Combustion and Emission, Narosa Publishing House, 2011.,

4 Obert., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 2009.

COURSE OUTCOMES (COs)	
CO1	Understand the concept of combustion in IC engines.
CO2	Gain knowledge about the combustion in SI and CI engines.

CO3		Gain insight on the development on recent technologies in IC engines.														
CO4		Familiarize with the applications of engine management system on the engine performance and emissions.														
CO5		Gain the knowledge in advances in IC engines														
CO6		Understand the concept of engine mapping														
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	L	H	H
	CO2	M	H				H				M				H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		L			L					H	H
	CO6	H			H										H	
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18PEAU064	**INTELLIGENT VEHICLE SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Computer Control of Vehicle System, Hybrid Electric and Fuel Cell Vehicles, Automotive Safety				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To understand the advanced vision system in vehicles, Autonomous vehicles and Intelligent Transportation System					

MODULE 1 INTRODUCTION TO INTELLIGENT VISION SYSTEM 9

Vision Based Driver Assistance System –Vehicle optical Sensor, Laser Radar - Non Contact ground velocity detecting Sensor, Road Surface Recognition Sensor - Vehicle Sensors for Electronic Toll Collection System - Components of a Vision Sensor System , Driver Assistance on Highways –Lane Recognition, Traffic Sign Recognition - Driver Assistance in Urban Traffic-Stereo Vision, Shape base analysis and Pedestrian Recognition

MODULE 2 VEHICLE INFORMATION SYSTEM & INTELLIGENT TRANSPORTATION 8

Intelligent Transportation System (ITS) – Vision for ITS Communications - Multimedia communication in a car –Current ITS Communication Systems and Services - Vehicle to Vehicle and Road to Vehicle Communication Systems - Inter and Intra Vehicle Communication - VANETS-Devices-Optical Technologies and Millimeter Wave technologies

MODULE 3 ADAPTIVE CONTROL TECHNIQUES FOR INTELLIGENT VEHICLES 8

Automatic Control Of Highway Traffic And Moving Vehicles - Adaptive Control –Gain Scheduling - Model Reference Adaptive Control - Self Tuning Adaptive Control System Model – System Identification Basics, Recursive Parameter Estimation, Estimator Initialization - Design Of Self-Tuning Controllers –Generalized Minimum Variance (GMV) Control, Pole Placement Control And Model Predictive Control.

MODULE 4 DECISIONAL ARCHITECHTURES FOR AUTONOMOUS VEHICLES 8

Control Architectures And Motion Autonomy –Deliberative Architectures, Reactive Architectures, Hybrid Architectures - Overview Of Sharp Architecture, Models Of Vehicles - Concepts Of Sensor Based Maneuver, Reactive Trajectory Following, Parallel Parking, Platooning - Main Approaches To Trajectory Planning, Non-Holonomic Path Planning.

MODULE 5 AUTONOMOUS VEHICLE AND CASE STUDIES 8

DARPA Challenge Case Study - ARGO Prototype Vehicle - The Gold System-The inverse Perspective Mapping, Lane Detection, Obstacle Detection, Vehicle Detection, Pedestrian Detection - Software systems architecture, Computational Performances - ARGO Prototype vehicle Hardware –Functionalities, Data acquisition System, Processing System and Control System

Text Books

1. Ljubo Vlacic, Michel Parent and Fumio Harashima,"Intelligent Vehicle Technologies", Butterworth-
Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
2. Ronald K Jurgen, "Automotive Electronics Handbook ", Automotive Electronics Series, SAE, USA, 1998.

Reference Books

1, Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei "Autonomous Vehicles Intelligent Transport Systems And Smart Technologies",Nova Publishers-2014–ISBN-978-1-63321-3265

COURSE OUTCOMES (COs)																
CO1	Understand the intelligent vision system used in automobiles															
CO2	Understand the architecture of intelligent transportation system															
CO3	Understand adaptive control techniques of an autonomous vehicle															
CO4	Understand about the successful autonomous vehicle projects															
CO5	Understand about the successful autonomous vehicle - case studies															
CO6	Understand about the successful prototype vehicle															
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	L	H	
	CO2	M	H				H				M				H	H
	CO3	H	H	H	M					H		M	H	H	H	
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		L			L					H	H
	CO6	M			M										H	H
3	Category	Professional Electives (PE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

OPEN ELECTIVES

U18OEAU001	**ELECTRIC AND HYBRID VEHICLES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Automotive Electrical and Electronics, Computer Control of Vehicle Systems
	Course Designed by- Department of Automobile Engineering
OBJECTIVE: To understand the principle, working and design of electric and hybrid vehicles.	

MODULE 1- ELECTRIC VEHICLES **9**

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

MODULE 2- ELECTRIC PROPULSION SYSTEMS & GENERATORS **9**

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking. DC generators, AC generators, voltage and frequency regulations

MODULE 3- HYBRID VEHICLES **9**

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

MODULE 4- MOTOR CONTROLLERS AND CONTROL SYSTEMS & ENERGY STORAGES **9**

Control system principles, speed and torque control – DC motors and AC motors. Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra-capacitors.

MODULE 5- FUEL CELLS & SOLAR CARS **9**

Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar carsphotovoltaic cells, tracking, efficiency and cost comparison.

TEXT BOOKS

1. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRS Press, 2014.
2. James Larminie and John Loury, “Electric Vehicle Technology-Explained”, John Wiley & Sons Ltd., 2013.

REFERENCE BOOKS

1. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Butterworth –Heinemann, 2012.
2 Donwhite Consultant Incorporate – Handbook of EMI / EMC – Vol I – 2015
3 Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2012
4 Ron Hodkinson and John Fenton, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth- Heinemann, 2011.

COURSE OUTCOMES (COs)	
CO1	To Understand the components of Electric Vehicle with its specification
CO2	To Know about electric propulsion systems and generators
CO3	To Concepts of Hybrid Vehicle with its merits and demerits

CO4		Familiarize with Motor Controllers and Control Systems & Energy Storages													
CO5		To Know and understand about Fuel Cells & Solar Cars													
CO6		Understand the concept of Hybrid Electric Vehicle with their auxiliary systems													
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	L	H	H
	CO2	M	H				H				L				H	
	CO3	H	H	H	M					H		M	H	H	H	H
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		M			H					H	H
	CO6	H			H										H	
3	Category		Open Electives (OE)													
4	Approval		47^{th} Meeting of Academic Council held in Aug, 2018													

U18OEAU002	**INTELLIGENT TRANSPORTATION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To learn fundamentals of ITS and functional areas of ITS.					

MODULE 1 – INTRODUCTION 9

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

MODULE 2 9

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System

MODULE 3 9

ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

MODULE 4 9

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

MODULE 5 9

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

References:

1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
2. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
3. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

COURSE OUTCOMES (COs)																
CO1		Understand the Introduction to Intelligent Transportation Systems														
CO2		To Understand the Importance of telecommunications														
CO3		Gain insight on ITS functional areas and advanced traffic management systems														
CO4		Familiarize with the types of Advanced Traffic Management Systems (ATMS)														
CO5		Gain the knowledge in Travel and Traffic management														
CO6		Understand the concept of Automated Highway Systems														
Mapping of Course Outcomes with Program outcomes (POs)																
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low																
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	L	H	H
	CO2	M	H				H				M				M	
	CO3	H	H	H	L					H		H	H	H	H	H
	CO4	H	H	M	M		L	H					M	M	H	H
	CO5	M	H	H	H		L			L					H	M
	CO6	H			H										H	
3	Category	Open Electives (OE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18OEAU003	**VIBRATION AND NOISE CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To learn about how to control noise and vibration in automobiles					

MODULE 1 – INTRODUCTION 9

Single degree of freedom, two degree of freedom, free, forced and damped vibrations modelling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber. Two degree of freedom system, modal analysis

MODULE 2 - NUMERICAL METHODS 9

Approximate methods for determining fundamental frequency, Dunkerleys lower bound, Rayleighs upper bound, Holzer method for closed coupled system and branched system.

MODULE 3 - CONTROL TECHNIQUES 9

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

MODULE 4 - AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

MODULE 5 - SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TEXT BOOKS

1 Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBM -81-297-0179-0 - 2004.
2 Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons.

REFERENCE BOOKS

1 Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2010.
2 Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2010.
3 Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2012.

COURSE OUTCOMES (COs)															
CO1	Understand about the degrees of freedom														
CO2	Gain knowledge about Numerical Methods														
CO3	The development on control techniques in isolating vibration														
CO4	Familiarize with Automotive Noise Sources.														
CO5	Gain the knowledge in Source of Noise and Control														
CO6	Understand the Methods of Controlling noise														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	H	H	H
	CO2	M	H				H				M				H	
	CO3	H	H	H	M					H		H	H	H	H	H
	CO4	H	H	M	M		L	M					M	M	H	H
	CO5	L	H	H	H		L			L					H	H
	CO6	H			H										H	
3	Category	Open Electives (OE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

U18OEAU004	**AUTOMOTIVE SENSORS AND APPLICATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Computer control of Vehicle Systems, Automotive Electronics				
	Course Designed by- Department of Automobile Engineering				
OBJECTIVE: To learn about how to control noise and vibration in automobiles					
Category	OE				
Approval	47th Meeting of Academic Council held in Aug, 2018				

MODULE 1 - INTRODUCTION **9**

Introduction to automotive sensors and instrumentation, Market perspective for sensors and instrumentation techniques. Sensor electronics and techniques. Overview of sensor measurements. Sensor linearization and characterization. Sensor classification. Signals and systems

MODULE 2 - SENSORS FOR ENGINES **9**

Sensors and interfacing- Pressure, position, flow, temperature, humidity, speed, acceleration, oxygen, torque, light, distance and level.

MODULE 3 – ACTUATORS **9**

Principles of actuation and control. DC motors, stepper motors. Relays and solenoids. Hydraulic and pneumatic actuators.

MODULE 4 - SENSORS FOR CHASSIS **9**

Sensors and interfacing techniques for Engine control, adaptive cruise control, braking control, traction control, steering and stability.

MODULE 5 - INTELLIGENT SENSORS **9**

Sensors for intelligent transport systems, Lighting, wipers, climate control and electronic displays. Sensors for occupant safety .The digital vehicle intelligent vehicle systems

TEXT BOOKS

1 E Q Doebelin, Measurement Systems, Application and Design, 4th edition, McGraw-Hill, 2012

2 William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes, 2016

REFERENCE BOOKS

1 Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2010.

COURSE OUTCOMES (COs)															
CO1	To learn about the Introduction to automotive sensors and instrumentation														
CO2	To Understand about various sensors for engines														
CO3	To Know the Principles of actuation and control														
CO4	To Learn about the various sensors for chassis														
CO5	To Study about the Sensors for intelligent transport systems														
CO6	To Familiarize about various Sensors and Actuators with its application														
Mapping of Course Outcomes with Program outcomes (POs)															
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low															
1	COs/POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	H				H			H			L	L	M	H
	CO2	M	H				H				H				H	
	CO3	H	H	L	M					H		M	H	H	M	H
	CO4	H	H	M	M		L	H					M	H	H	L
	CO5	M	H	H	M		L			L					H	H
	CO6	H			H										M	
3	Category	Open Electives (OE)														
4	Approval	47th Meeting of Academic Council held in Aug, 2018														

CURRICULUM AND SYLABUS (R2018)

CHOICE BASEDFLEXIBLE CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

B.Tech –Mechanical Engineering

FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	4	0	0	4
3	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
8	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
9	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
10	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	35	17	0	14	20.5

*** Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics- II	4	4	0	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
11	18MCAB203	MC	Yoga	2	0	0	2	0
12	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	17	1	12	25.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA302	BS	Partial Differential Equations, Probability andStatistics	4	3	1	0	4
2	U18ESME 301	ES	Engineering Mechanics	4	3	1	0	4
3	U18PCME302	PC	Materials Engineering	3	3	0	0	3
4	U18PCME303	PC	Thermodynamics	4	3	1	0	4
5	U18PCME304	PC	Manufacturing Processes	3	3	0	0	3
6	U18PCME305	PC	Fluid Mechanics and Machinery	4	3	1	0	4
PRACTICAL								
7	U18PCME3L1	PC	Machine Drawing	2	0	0	2	1
ACTIVITY BASED COURSES								
8	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
9	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	28				23

SEMESTER IV								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCME401	PC	Applied Thermodynamics	4	3	1	0	4
2	U18BSMA401	BS	Numerical Methods	4	3	1	0	4
3	U18PCME 402	PC	Strength of Materials	4	3	1	0	4
4	U18PCME403	PC	Manufacturing Technology	3	3	0	0	3
5	U18PCME404	PC	Instrumentation and Control	3	3	0	0	3
6	U18PCME405	PC	Theory of Machines	4	3	1	0	4
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
8	U18PCME4L1	PC	Strength of Materials and Fluid Mechanics Lab	2	0	0	2	1
9	U18PCME4L2	PC	Metallurgy and Metrology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0

Total	32				24

SEMESTER V								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCME501	PC	Heat Transfer	4	3	1	0	4
2	U18PCME502	PC	Computer Aided Design	3	3	0	0	3
3	U18PCME503	PC	Machine Design –I	4	3	1	0	4
4	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
5		PE	PEC-I	3	3	0	0	3
6		PE	PEC-II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
8	U18PCME5L1	PC	Thermal and Heat Transfer Engineering Laboratory	2	0	0	2	1
9	U18PCME5L2	PC	Instrumentation and Dynamics Lab	2	0	0	2	1
10	U18PCME5L3	PC	Manufacturing Technology lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	32				23

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCME601	PC	Machine Design –II	4	3	1	0	4
2		PE	PEC-III	3	3	0	0	3
3		PE	PEC-IV	3	3	0	0	3
4	U18PCME602	PC	Finite Element Analysis	4	3	1	0	4
5	U18BSMA601	BS	Operational Research	3	3	0	0	3
5	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
6	U18PCME6L1	PC	CAD/CAM Lab	2	0	0	2	1
7	U18EEEA6L2	EEC	Soft Skill	2	0	0	2	1
8	U18EEME6L3	EEC	Summer Internship	0	0	0	0	1
ACTIVITY BASED COURSES								
9	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
10	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0

Total	27				20

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCME701	PC	Automation in Manufacturing	3	3	0	0	3
2		PE	PEC-V	3	3	0	0	3
3		OE	OEC-I	3	3	0	0	3
4		OE	OEC-II	3	3	0	0	3
PRACTICAL								
6	U18PCME7L1	PC	Design and Analysis Lab	2	0	0	2	1
7	U18EEME7P1	EE	Project –I	8	0	0	8	4
ACTIVITY BASED COURSES								
8	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
9	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	26				17

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	PEC –VI	3	3	0	0	3
		OE	OEC III	3	3	0	0	3
2		OE	OEC –IV (MOOC)	2	2	0	0	2
PRACTICAL								
3	U18EEME8P2	EEC	Project –II	16	0	0	16	8
ACTIVITY BASED COURSES								
4	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	24				16

Total Credit: 169

LIST OF PROFESSIONAL ELECTIVES

Professional Core Elective -I

Code No.	Specialization	Course Title	L	T	P	C
U18PEME011	Thermal	Advanced Internal Combustion Engines	3	0	0	3
U18PEME012	Design	Design for Manufacturing	3	0	0	3
U18PEME013	Manufacturing	Special casing Process	3	0	0	3
U18PEME014	Manufacturing	Industrial Engineering	3	0	0	3

Professional Core Elective -II

Code No.	Specialization	Course Title	L	T	P	C
U18PEME021	Thermal	Power Plant Engineering	3	0	0	3
U18PEME022	Design	Tribology	3	0	0	3
U18PEME023	Materials Engineering	Composite Materials and Technology	3	0	0	3
U18PEME024	Manufacturing	Industrial Robotics	3	0	0	3

Professional Core Elective -III

Code No.	Specialization	Course Title	L	T	P	C
U18PEME031	Thermal	Gas Dynamics and Jet Propulsion	3	0	0	3
U18PEME032	Design	Design of Jigs fixtures and press Tools	3	0	0	3
U18PEME033	Manufacturing	Unconventional Machining Process	3	0	0	3
U18PEME034	Manufacturing	Process Planning and Cost Estimation	3	0	0	3

Professional Core Elective -IV

Code No.	Specialization	Course Title	L	T	P	C
U18PEME041	Automobile	Automobile Engineering	3	0	0	3
U18PEME042	Design	Mechanical Vibrations	3	0	0	3
U18PEME043	Thermal	Advance Turbo Machines	3	0	0	3
U18PEME044	Industrial Management	Total Quality Management	3	0	0	3

Professional Core Elective -V

Code No.	Specialization	Course Title	L	T	P	C
U18PEME051	Thermal	Refrigeration and Air conditioning	3	0	0	3
U18PEME052	Thermal	Computational Fluid Dynamics	3	0	0	3
U18PEME053	Design	Mechanics of Fracture	3	0	0	3
U18PEME054	Industrial Management	Principles of Managements	3	0	0	3

Professional Core Elective -VI

Code No.	Specialization	Course Title	L	T	P	C
U18PEME061	Thermal	Combustion Engineering	3	0	0	3
U18PEME062	Thermal	Design of Heat Exchanger	3	0	0	3
U18PEME063	Design	Rapid prototyping	3	0	0	3

U18PEME064	Industrial Engineering	Plant layout and Material Handling	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion
41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance

43.U18OEEE003-Energy Conservation Techniques

44.U18OEEE004-PLC and SCADA for Industrial

45.U18OEEC-001-Communication Systems

46. U18OEEC-002-VLSI circuits

47. U18OEEC-003-Image Processing Techniques

48.U18OEEC-004-Communication Networks

49. U18OEEC-005-An Introduction to DSP

50. U18OEEC-006-Basics of IoT

51. U18OEBM001-Medical Radiation Safety Engineering

52. U18OEBM002-Medical Waste Management

53. U18OEBM003-Quality Control in Healthcare

54. U18OEBM004-Wearable Technology

55.U18OEEI001-Analytical Methods and Instrumentation

56.U18OEEI002-Introduction to process Data Analytics

57.U18OEEI003-Reliability and Safety in Process industries

58.U18OEEI004-Multi sensor data fusion

59. U18OEBT001- Bioprocess Economics & Plant Design

60. U18OEBT002-Brewing technology

61. U18OEBT003-Biomining

62. U18OEBT004-Industrial Safety Engineering

63. U18OEAC001-Geo- informatics for Precision Farming

64. U18OEAC002-Livestock and poultry management

65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies

66. U18OEAC004-Soil and Water Conservation Engineering

67. U18OEIT001-Block Chain Technology

68. U18OEIT002-Semantic Web

69. U18OEIT003-Entrepreneurship Development

70. U18OEIT004-Ethical Hacking Techniques

71. U18OECS004-Mobile Application Development

72. U18OECS005-System Modelling and Simulation

73.U18OECS006-Web Programming

74.U18OECS007-Virtual Reality

75. U18OECS008- E Commerce

76.U18OEGE001-Metagenomics and Epigenomics

77.U18OEGE002-Molecular Genetics and Genomics

78.U18OEGE003-Principles of Molecular cell biology

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HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	3	1	1	0	3
3	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
Total Credit								9

BASIC SCIENCE (BS)

S.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
2	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	U18BSMA201	BS	Engineering Mathematics- II	4	3	1	0	4
5	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
6	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
7	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
8	U18BSMA302	BS	Partial Differential Equations and Probability &Statistics	4	3	1	0	4
9	U18BSMA401	BS	Numerical Methods	4	3	1	0	4
10	U18BSMA601	BS	Operations Research for Engineers	3	3	0	0	3
PRACTICAL								
10	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
11	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
Total Credits								36

ENGINEERING SCIENCE COURSES (ES)

S.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
4	U18ESME 301	ES	Engineering Mechanics	4	3	1	0	4
PRACTICAL								
4	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
5	U18ESME1L2	ES	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
6	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
Total Credits								19

PROFESSIONAL CORE COURSES

S.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18PCME302	PC	Materials Engineering	3	3	0	0	3
2	U18PCME303	PC	Thermodynamics	4	3	1	0	4
3	U18PCME304	PC	Manufacturing Processes	3	3	0	0	3
4	U18PCME305	PC	Fluid Mechanics and Machinery	4	3	1	0	4
5	U18PCME401	PC	Applied Thermodynamics	4	3	1	0	4
6	U18PCME 402	PC	Strength of Materials	4	3	1	0	4
7	U18PCME403	PC	Manufacturing Technology	3	3	0	0	3
8	U18PCME404	PC	Instrumentation and Control	3	3	0	0	3
9	U18PCME405	PC	Theory of Machines	4	3	1	0	4
10	U18PCME501	PC	Heat Transfer	4	3	1	0	4
11	U18PCME502	PC	Computer Aided Design	3	3	0	0	3
12	U18PCME503	PC	Machine Design -I	4	3	1	0	4
13	U18PCME601	PC	Machine Design -II	4	3	1	0	4
14	U18PCME602	PC	Finite Element Analysis	4	3	1	0	4
15	U18PCME701	PC	Automation in Manufacturing	3	3	0	0	3

PRACTICALS								
16	U18PCME3L1	PC	Machine Drawing	3	0	0	3	1
17	U18PCME4L1	PC	Strength of Materials and Fluid Mechanics Lab	3	0	0	3	1
18	U18PCME4L2	PC	Metallurgy and Metrology Lab	3	0	0	3	1
19	U18PCME5L1	PC	Thermal and Heat Transfer Engineering Laboratory	3	0	0	3	1
20	U18PCME5L2	PC	Instrumentation and Dynamics Lab	3	0	0	3	1
21	U18PCME5L3	PC	Manufacturing Technology lab	3	0	0	3	1
22	U18PCME6L1	PC	CAD/CAM Lab	3	0	0	3	1
23	U18PCME7L1	PC	Design and Analysis Lab	3	0	0	3	1
Total Credits								62

EMPLOYABLITY ENHANCEMENT COURCES (EE)

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
PRACTICAL								
1	U18EEEA6L2	EEC	Soft Skill	2	0	0	2	1
2	U18EEME6L3	EEC	Summer Internship	0	0	0	0	1
3	U18EEME7P1	EEC	Project –I	8	0	0	8	4
4	U18EEME8P1	EEC	Project –II (Main Project)	16	0	0	16	8
Total Credits								14

MANDATORY COURSES (MC)

SEM	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	U18MCTH401	MC	Constitution of India	2	2	0	0	0
2	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
3	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
ACTIVITY BASED COURSES								
1	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
1	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
2	U18MCAB203	MC	Yoga	2	0	0	2	0
2	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
3	U18MCAB305	MC	Culture- Learning an art	2	0	0	2	0

			form					
3	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
4	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
4	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
5	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
5	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
6	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
6	U18MCAB612	MC	Self Development-religion and Inter-faith	2	0	0	2	0
7	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
7	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
8	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total Credits				36	6	0	30	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No.	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences (HS)	3	3	-	-	3	-	-	-	9	5.33
2	Maths& Basic Sciences (BS)	10	15	4	4	-	3	-	-	36	21.30
3	Engineering Sciences (ES)	7.5	7.5	4	-	-	-	-	-	19	11.25
4	Professional Core (PC)	-	-	15	20	14	9	4		62	36.69
5	Professional Electives (PE)	-	-	-	-	6	6	3	3	18	10.65
6	Open Electives/ MOOC (OE)	-	-	-	-	-		6	5	11	6.51
7	Project Work, Seminar, Internship, Term Paper, etc. (EE)	-	-	-	-	-	2	4	8	14	8.28
8	Mandatory course(MC)	0	0	0	0	0	0	0	0	0	0
	Total Credit	20.5	25.5	23	24	23	20	17	16	169	
	Total Contact Hour	35	36	28	32	32	27	26	25	241	241

TOTAL CREDITS=169

U18HSEN101	COMMUNICATIVE ENGLISH	L	T	P	C
	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Coordinator Name & Department:-				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	3										**3**	
2		**2**							**2**			
3			**3**							**3**		
4				**3**		**2**						
5					**3**		**3**	**1**				

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations -introducing oneself – exchanging personal information- narrating events, -incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 15

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning,USA: 2007
5. Practical English Usage. Michael Swan. OUP. 2005.
6. Remedial English Grammar. F.T. Wood. Macmillan.2007
7. On Writing Well. William Zinsser. Harper Resource Book. 2001

Course Coordinator HOD

U18BSMA101	Engineering Mathematics – I	L	T	P	C
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Coordinator Name & Department:-				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

CO/PO Mapping
3 – Strong, 2 – Medium, 1 – Weak

COs	**Programme Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	3				2		1			1		
CO2	3		3	1	2			2				
CO3	3				2				1			
CO4	3	2			2				1			
CO5	3		3		2				2	1		

Category	Basic Science (BS)
Approval	47th Academic Council Meeting held in Aug, 2018

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

Course Coordinator **HOD**

U 18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course Coordinator Name & Department:-				

OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

Mapping of Course Outcomes with Programme Outcomes (POs)
3 – Strong, 2 – Medium, 1 – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**	**l**
2	CO1	3	3	2	3	2			2	3	3		3
	CO2	1	3	2	2	3			2		1	3	
	CO3	3	1			1			2	2		2	
	CO4	3	1			1			2	2		2	
	CO5	3	2	2	2				2		3	1	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A & B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) Brij Lal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Coordinator **HOD**

U18BSCH101	ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Coordinator Name & Department:-				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping: 3 – Strong, 2 – Medium, 1 – Weak

COs	Programme Outcomes (POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3			2		3		3		1		
CO2		1	3		2		3		2		1	
CO3		2		3		1				2		3
CO4	3		2	1			2			3		
CO5		3		1		2				3		

Category	Basic Science (BS)
Approval	47th Academic Council Meeting held in Aug, 2018

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS **9**

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara “A text book of Engineering Chemistry” S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

Course Coordinator **HOD**

U18ESCS101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Coordinator Name & Department:-				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)

CO/SO Mapping: 3 – Strong, 2 – Medium, 1 – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3	3	2	3	2	1		2	1	2	3
	CO2	3	3	2	2		2		1			2	
	CO3	2	2	1	3	2		1		1		2	3
	CO4	2	2	1	2	3	2	1	2	1		2	
	CO5	2	3	1	2	2			2	2	1		
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, – An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

Course Coordinator **HOD**

U18ESME101	Engineering Graphics & Design (Theory & Lab.)	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Coordinator Name & Department:-				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3			2			3					
	CO2	3	3	1		3	2						3
	CO3			3									
	CO4											3	
	CO5	3						1					3
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning

and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE4: SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

Course Coordinator **HOD**

U18BSPH2L1	WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace & Auto)	L	T	P	C
		0	0	3	1.5
	Total Contact Hours - 45				
	Prerequisite – **Wave Optics and Mechanics**				
	Course Coordinator Name & Department:-				
OBJECTIVES: To impart Practical knowledge of Physics to the students					

Course Outcome (CO's)	
CO1	Understand the fundamental concept of optics
CO2	Understand the concept of production of ultrasonic waves
CO3	Understand the basic concept of Mechanics

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping: 3 – Strong 2 – Medium 1-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3		3	3				3	1	2	3	
	CO2	3	3	1					3	1	2		3
	CO3	3	3	1					3	2	2		
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

Course Coordinator **HOD**

U18BSCH2L4	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Coordinator Name & Department:-				

OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Studentswill be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Students will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES
3 – Strong, 2 – Medium, 1 – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2	2		3		3		1		
CO2	1	3			2		3		2		1	
CO3		2		2						2		3
CO4	3		2				2				3	
CO5		3		1		2				3		3

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, “Practical Chemistry”, Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

Course Coordinator **HOD**

U18ESCS1L1	PROBLEM SOLVING AND PYTHON PROGRAMMI LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Coordinator Name & Department:-				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	K	l
2	CO1	3	3	2	3	3	2	2	2	2		2	2
	CO2	3	3	1	3	3	2	1	2	2	2	2	
	CO3	3	3	2	2	2	2		2	2	2	2	3
	CO4	3	2	3	3	3	2	2	2	2	1		
	CO5	3	3	2	3	2	2		2	2	1	2	3
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux and Scilab

Course Coordinator **HOD**

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Coordinator Name & Department:-				
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.				

COURSE OUTCOMES (COs)

On completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	**2**										**3**	
2		**3**							**2**			
3			**3**							**3**		**3**
4				**2**		**3**						
5					**2**		**2**	**1**				

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development – subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

Course Coordinator **HOD**

U18BSMA201	Engineering Mathematics II (Common to B.Tech – Civil, Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, ECE, BME, CSE & IT)	L	T	P	C
	Total Contact Periods - 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Coordinator Name & Department:-				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping
3 – Strong, 2 – Medium, 1 – Weak

COs	Programme Outcomes (POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2		1		3				2		3	
CO2	3	2			3			2		1		3
CO3	3		1				2		3			3
CO4								3	2	2	1	
CO5	3		1	1			2				3	
Cate	Basic Science (BS)											
App	47th Academic Council Meeting held in Aug, 2018											

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS
(9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions

– properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.

George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12thEdition, Addison-Wesley, Pearson.

Course Coordinator **HOD**

U18BSPH201	INTRODUCTION TO MECHANICS	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course Coordinator Name & Department:-				

OBJECTIVE	To impart basic knowledge of mechanics involving 1D, 2D and 3D motion ofa rigid body

COURSE OUTCOMES

CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/PO Mapping: 3 – Strong, 2 – Medium, 1 – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**	**l**
2	CO1		1	1					2	1	2		3
	CO2	3	1	1	3				2	1	2	1	
	CO3	2			2				3	2			2
	CO4	3	1	1					2	1	2	1	
	CO5	1	3	3	2				2	1	1	1	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of the Academic Council held in Aug, 2018											

UNIT 1

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.
2. M.K. Harbola, "Engineering Mechanics", 2nd edition, Cengage, 2013.
3. M.K. Verma, "Introduction to Mechanics", 1st edition, CRC press, 2009.
4. D.Kleppner&R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, "Engineering Mechanics – DynamicsVol 2", 7th ed. Wiley, 2012
6. JP Den Hartog, "Mechanical Vibrations", Dover Publications, Inc., 1985
7. WT Thomson, "Theory of Vibrations with Applications", Pearson, 5th edition, 1997.
8. Online References: Wikipedia org

Course Coordinator **HOD**

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Coordinator Name & Department:-				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/SO Mapping: 3 – Strong, 2 – Medium, 1 – Weak

COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	**l**
CO1	3			2		3		3		1		3
CO2	1	3	3		2		3		2		1	
CO3		2				1			3	2		
CO4	3		2	1			2				2	3
CO5		3		1		2				3		

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert

ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder-Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.
Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

Course Coordinator HOD

U18BSBT101	BIOLOGY FOR ENGINEERS	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Coordinator Name & Department:-				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure
CO2	To understand about biodiversity and its conservation
CO3	To know the fundamentals of genetics and the immune system
CO4	To create an awareness about human diseases
CO5	To give a basic knowledge of the applications of transgenics
CO6	To know the applications of bio systems in environment, medical and agricultural sectors

Mapping of Course Outcomes with Programme Outcomes
(S/M/W indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POS	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3					2	2			3	2	2
	CO2	3			2		3		2	2			
	CO3	2		2			2						3
	CO4							3			2	2	
	CO5	3	3					3	2	2			
	CO6	3						3				3	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

Course Coordinator **HOD**

U18ESEE101	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Physics				
	Course Coordinator Name & Department:-				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

COURSE OUTCOMES (COs)	
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO2	To gain knowledge regarding fundamentals of AC circuits.
CO3	To gain knowledge regarding electrical machines and transformers.
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.
CO5	To gain knowledge on principles of digital electronics systems.

Mapping of Course Outcomes with Programme Outcomes
3 – Strong, 2 – Medium, 1 – Weak

1	COs/POS	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	1			2				3		1	
	CO2	3	1			2				3		1	3
	CO3	3	2			2				3		1	3
	CO4	3	1			2				3		1	
	CO5	3	1			2				3		1	3
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

MODULE 1 : DC CIRCUITS 12

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS 9

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS 9

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

Course Coordinator **HOD**

U18ESME1L2	Workshop/Manufacturing Practices Laboratory	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Coordinator Name & Department:-				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POS	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1											3	
	CO2			3	2							3	
	CO3		2										3
	CO4	3			1							3	2
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.

b) Mortise and Tenon joints.
c) Cross Half joints.
d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**

Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**

a) Forming &Bending:
b) Model making–Trays, funnels, etc.
c) Different type of joints

6. Demonstration **(6 Hours)**

Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Course Coordinator **HOD**

U18ESEE1L3	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Coordinator Name & Department:-				

OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics Components and circuits.

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flaps

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	Cos/POS	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3			3				3		2	
	CO2	3	3			3				3		2	3
	CO3	3	3			3				3		2	
	CO4	3	3			3				3		2	
	CO5	3	3			3				3		2	3
	CO6	3	3			3				3		2	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging – slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.

2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops – JK and RS
5. Applications of Operational Amplifier

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

Course Coordinator **HOD**

U18BSMA302	**Partial Differential Equations , Probability and Statistics**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Engineering Mathematics I & II				
	Course Coordinator Name & Department:-Ms S.Priyanka& Dept.of Mathematics				

OBJECTIVES

- Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.
- Learn techniques of solving the standard types of first order and second order partial differential equations.
- Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem.
- Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases.
- Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample.

COURSE OUTCOMES (Cos)

CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.
CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.
CO5	Learn the basic idea of statistics including measures of central tendency .
CO6	Identify the appropriate hypothesis testing procedure based on type of outcome variable and number of samples.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	2				3	2	3	1	2			2
	CO2	2	3	1		3	2	1			2	2	2
	CO3	3	3	3	1				1		1		3
	CO4	3	3	2	1			1		2		3	3
	CO5	3	3		1		2	1	1			3	3
	CO6	3	3				2		1			3	
	Category	Basic Sciences											
4	Approval	47th Academic Council, July 2018											

UNIT I FOURIER SERIES 12Hrs

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 12Hrs

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 12Hrs

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT 1V PROBABILITY DISTRIBUTION 12Hrs

Probability – Axioms of probability – Conditional probability – Baye's theorem –Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS 12Hrs

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. S.C.Gupta&V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi , 2003. [Units I to III].

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability for Engineers" , 6thEdn. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.for Engineers" , 6thEdn. Wiley India Pvt Ltd., New Delhi-2. 2010.
6. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

Course Coordinator **HOD**

Ms S.Priyanka. **Dr. K. Balasubramanian**

U18ESME301	ENGINEERING MECHANICS	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Engineering Mathematics I , II, Engg. Physics				
	Course Coordinator Name & Department:-– Mr. V. Jose Ananth Vino ,Department of Mechanical Engineering				

OBJECTIVES: To understand the concept of basic engineering mechanism

COURSE OUTCOMES (COs)

CO1	Students will understand the concepts and behaviour of engineering mechanics
CO2	Students will demonstrate and draw the vectorial representation of forces and moments
CO3	Students will be able to differentiate between machines and mechanisms..
CO4	Students will gain knowledge regard be able to examine various types of forces and reactions and draw the free body diagram for complicated structures..
CO5	Student will gain knowledge in solving problems involving work and energy
CO6	Student will gain knowledge on friction on equilibrium and its application.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3	1	3		3		1		3	3	3
	CO2						3	3	1				
	CO3						3	3	1		2		
	CO4						3	3	1		2		2
	CO5						3	3	1		2		
	CO6						3	3	1		2		1
	Category	Engineering Sciences											
4	Approval	47th Academic Council, July 2018											

UNIT I **12**

Introduction - Units and Dimensions - Laws of Mechanics **– Lame's theorem, Parallelogram and triangular Law** of forces – Vectors –Vectorial representation of forces and moments – Vector operations on forces - Coplanar Forces – Resolution and Composition of forces – Resultant of several concurrent forces - Equilibrium of a forces – Forces in space - Equilibrium of particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II **12**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples– Scalar components of a moment – **Varignon's theorem** - Equilibrium of Rigid bodies in two dimensions -Equilibrium of Rigid bodies in three dimensions.

UNITIII **12**

Determination of areas – First moment of area and the Centroid of standard sections – T section, I section, Composite figures, Hollow section – second moments of plane area – Rectangle, triangle, circle - T section, I section, Hollow section – Parallel axis theorem and

perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Basic concept of Mass moment of inertia.

UNITIV **12**

Frictional force – Laws of Coloumb friction – Cone of friction – Angle of repose – Simple contact friction – Sliding of blocks – Wedge friction - Ladder friction – Screw Jack – Belt friction - Rolling resistance.

UNIT V **12**

Displacements, Velocity and acceleration, their relationship – Relative motion – Relative acceleration – Curvilinear motion of particles – **Newton's law** – work energy equation – impulse and Momentum – Impact ofelastic bodies.

TEXT BOOK:

1. Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers: Vol. 1 Statics and vol. 2 Dynamics**"**, McGraw-Hill International Edition, 2013.
2. Rajasekaran, S, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2011.

REFERENCES :

1. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition – Pearson Education Asia Pvt., Ltd., 2006.
2. Kumar, K. L Kumar, V., Engineering Mechanics, Tata McGraw – Hill, New Delhi, 2010
3. Palanichamy, M.S., Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw - Hill, 2013.
4. Timoshenko, and Young, Engineering Mechanics, Tata McGraw-Hill, New Delhi, 2013.

Course Coordinator **HOD**

Mr.Jose Ananth Vino **Dr. K. Balasubramanian**

U18PCME302	MATERIALS ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Basic Physics and Chemistry				
	Course Coordinator Name & Department:-Dr. C. M. Meenakshi Department of Mechanical Engineering				

OBJECTIVES

- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

COURSE OUTCOMES (COs)

CO1	Student will be able to identify crystal structures for various materials and understand the defects in such structures
CO2	Student gain knowledge in selecting materials
CO3	Student will be able predict the mechanical properties of materials
CO4	Student will be able to derive the material properties of ferrous and non-ferrous alloys
CO5	Student will be able to interpret surface engineering techniques
CO6	Student will be able build mechanical integrity and deduct failure in materials

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3		3									
	CO2	3		3									
	CO3	3		2							2		
	CO4	2	3		1								
	CO5					2							
	CO6											3	2
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Structure of metals, alloysand ceramics – Molecules and bonding – Crystal structure: Inter atomic distance and Ionic radii, polymorphism, Miller indices of atomic planes, Bragg's law, crystal defects – point, line and plane defects – Effect of crystal imperfection on mechanical properties- strengthening mechanism for improvement of mechanical properties – Allotropy, grain and grain boundaries, Slip system, critically resolved shear stress, Schmid's law.

UNIT II **8**

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT III **9**

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Creep, Introduction to non-destructive testing (NDT)

UNIT IV **10**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium

UNIT V **9**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

TEXT BOOKS:

1. Callister W.D, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Dieter G.E, Mechanical Metallurgy, McGraw Hill ISE, 1999.
3. Jindal U.C, “Engineering Materials and Metallurgy”, Pearson, 2011
4. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
5. Raghavan V, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.

REFERENCES:

1. Arumugam, M.Material Science, Anuradha Publishers, 1997.
2. Flinn R.A& Trojan P.K, Engineering Materials and their Applications
3. Rajan, T.V. Sharma and Ashok Sharma, Heat Treatment – Principles and their techniques, Prentice Hall of India Pvt. Ltd., 2004.
4. www.studynama.com/.../315-Engineering-materials-**metallurgy**-lecture-n**…**

Course Coordinator **HOD**

Dr.C. M. Meenakshi **Dr. K. Balasubramanian**

U18PCME303	**THERMODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – MATHEMATICS –I &II				
	Course Coordinator Name & Department:-Mr. V. Srinivasan, Department of Mechanical Engineering				

OBJECTIVES

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

COURSE OUTCOMES (COs)

CO1	To calculate energy balance to the systems and control volumes, in situations involving heat and work interactions
CO2	Derive second law of thermodynamics and estimate carnot cycle problems.
CO3	Compare the various types of steam and gas power cycles.
CO4	Evaluate changes in thermodynamic properties of substances
CO5	Estimate the performance of energy conversion devices
CO6	Differentiate between high grade and low grade energies.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3	3			3		1	3		2	3
	CO2						3		1			2	
	CO3						3		1			2	3
	CO4						3		1			2	3
	CO5						3		1			2	
	CO6						3		1			2	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT-I **(12)**

Fundamentals - System & Control volume; Property, State & Process; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; Temperature, Definition of thermal equilibrium and Zeroth law; Definition of heat; First Law for Cyclic & Non-cyclic processes; Concept of Internal energy and Enthalpy. Application to closed and open systems, steady and unsteady flow processes.

UNIT-II **(12)**

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases

UNIT-III **(12)**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

UNIT-IV **(8)**

Thermodynamic cycles - Basic Rankine, Brayton cycle, effect of reheat, regeneration and intercooling and comparison with Carnot cycle.

UNIT-V (12)

Ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume.Exergy balance equation and Exergy analysis.

TEXT BOOKS:

1. Nag P.K-Basic and Applied Thermodynamics-Tata McGraw Hill Publishing Company, 2002
2. Rajput R.K-Engineering Thermodynamics-Laxmi Publications

REFERENCES:

1. Somasundaram S.C-Thermal Engineering-New Age International (P) Ltd,1996
2. Rao Y.V.C-An Introduction to Thermodynamics-New Age International (P) Ltd, 2004
3. YunusA.Cengel-Thermodynamics-International Edition, 2006
4. bookboon.com/en/engineering-**thermodynamics-ebook**

Course Coordinator

Mr. V. Srinivasan

HOD

Dr. K. Balasubramanian

U18PCME304	MANUFACTURING PROCESSES	L	T	P	C
	Total Contact Hours –45	3	0	0	3
	Prerequisite- Manufacturing Practices				
	Course Coordinator Name & Department:-Dr. R. J. Golden Renjith Nimal& Department of Mechanical Engineering				

OBJECTIVES

- To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

COURSE OUTCOMES (COs)

CO1	Recall the concepts of basic manufacturing process.
CO2	Explore the importance of various manufacturing process.
CO3	Evaluate the cutting forces and prevent the failures of machine tool.
CO4	Analyze the principles of metal cutting in Lathe.
CO5	Discuss the working principle of various Metal cutting machines.
CO6	Improve surface finish in the given components using grinding machines.

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**												
1	COs/POs	a	b	c	d	e	F	g	h	i	j	k	l
2	CO1	2	2	3		1	1	2	1	1	1	2	2
	CO2	1	2	3				1	1	2			
	CO3	2	2	2			1	2					
	CO4	3	2	3			1	1	1	1			1
	CO5	3	2	3									
	CO6	3	2	3			1	1	1	1			
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Mechanical working of metals-Forming, hot and cold working-rolling, extrusion, spinning, wire- drawing, press working. Welding - different types of gas and arc welding process, soldering and brazing. Foundry: Pattern, pattern materials, types, moulding, Cupola Furnace. Casting: Sand casting using Green sand mould,Die casting, centrifugal casting, casting defects and inspection.

UNIT II **8**

Introduction, mechanics of metal cutting- chip formation, Merchant's circle theory, cutting force calculations, tool materials, Influence of tool angles, tool life, cutting fluids, machining time calculations, Metal cutting economics, problem in merchant circle, machining time and economics.

UNIT III **10**

Lathe- Introduction, types, construction, mechanisms, operations and attachments, nomenclature of single point cutting tool. Capstan and turret lathes: various mechanisms, tool and loading arrangement. Automatic lathes- single spindle and multi spindle mechanisms.

UNIT IV **10**

Shaper, planer and slotter: types, specification, mechanisms, operations, holding devices, difference between shaper and planer. Milling machine - types and specification, mechanisms, holding devices, milling operations.Milling tool nomenclature, indexing types-simple, compound and differential.

UNIT V **8**

Drilling, Boring- Specification.Nomenclature of drilling and reaming tool and its specification.Broaching: Specification, types, mechanisms, nomenclature of broaching tool.
Surface Finishing: Grinding, Honing, Polishing, Buffing, Metal Spraying, Galvanizing, Anodizing, Electroplating and Super finishing.

TEXT BOOKS:

1. Degarmo, Black &Kohser, Materials and Processes in Manufacturing
2. HajraChowdary S.K. The Fundamentals of Work Shop Technology. Vol. I & II, Media Publishers, 1997
3. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
4. Sharma P.C, A Text Book of Production Technology, S.Chand& Company Ltd, New Delhi, 2007

REFERENCES:

1. Chapman W.A.J. - Work shop technology, vol I,II& III, 1975, ELBS.
2. Rao P.N.. Manufacturing Technology - Foundry Forging & Welding, TMH., New Delhi –2009.
3. Roy.A.Lindberg, Processes and Material Manufacture, PHI, 1995
4. www.studynama.com/.../301-Manufacturing-Technology-1-lecture-notes..

Course Coordinator **HOD**

Dr. R. J. Golden Renjith Nimal **Dr. K. Balasubramanian**

U18PCME 305	**FLUID MECHANICS AND MACHINERY**	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – MATHEMATICS I & II				
	Course Coordinator Name & Department:-**Mr. Arun V Rejus Kumar &**Department of Mechanical Engineering				

OBJECTIVES

- To learn about the application of mass and momentum conservation laws for fluid flows To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows To analyze the flow in water pumps and turbines.

COURSE OUTCOMES (COs)

CO1	Apply mathematical knowledge to predict the properties and characteristics of a fluid
CO2	Can understand different types of flow.
CO3	Understand dimensional analysis
CO4	Learn Fluid Dynamics and kinematics
CO5	Understand working principle of pumps
CO6	Understand working principle of turbines

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	E	f	g	h	i	j	k	l
2	CO1	3	3	1					2	2		3	3
	CO2	3	3	1					2	2		3	2
	CO3	3	3	1					2	2		3	3
	CO4	3	3	1					2	2		3	
	CO5	3	3	1					2	2		3	3
	CO6	3	3	1					2	2		3	2
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Unit-I **9**

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

Unit-II **9**

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.

Unit-III **9**

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis. Centrifugal pumps, Pump outlet and efficiencies-Cavitations, pump characteristics, multistage pumps, axial flowpumps-characteristics, construction details,Non-dimesnsionalparameters-Efficiencies-reciprocating pumps, Indicator diagram-Rotary pumps – Classifications, Working.

Unit-IV **8**

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle**.**

Unit-V **8**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Text Book:

1. Dr.R.K.Bansal. Fluid Mechanics-Laxmi Publication.
2. Modi and Seth-Fluid Mechanics and Hydraulic Machines, 2005.

References:

1. Agarwal.S.K.Fluid Mechanics and Machinery-McGraw Hill,1999.
2. Jain.A.K.Fluid Mechanics-Khanna Publishers,2009.
3. Kumar D.S-Fluid Mechanics and Fluid Power Engineering, S.K.Kataria&Sons,1998.
4. Mohanty, Fluid Mechanics, PHI,2000.
5. https://books.google.co.in/.../**Fluid_Mechanics_and_Machinery**.html?id

Course Coordinator **HOD**

Mr. Arun V Rejus Kumar **Dr. K. Balasubramanian**

U18PCME3L1	**MACHINE DRAWING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – ENGINEERING GRAPHICS				
	Course Coordinator Name & Department: Mr.Hariharan, Department of Mechanical Engineering				

OBJECTIVES

- To make the students understand and interpret drawings of machine Componentsso as to prepare assembly drawings.
- To familiarize the students with Indian Standards on drawing practices and standard components.

COURSE OUTCOMES (COs)	
CO1	To discover good interpretation of machine components
CO2	To demonstrate standardization of drawings.
CO3	Student will demonstrate Indian and International standard components.
CO4	To make use of industrial standard.
CO5	Decide what tolerance and fits and assembly
CO6	Imagine to Learn the difference between free sketching and machine drawing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	Cos/POs	a	b	c	d	E	f	g	h	i	j	k	l
2	CO1	3	2	3			1	1	1	1	1	1	
	CO2	3	2	3			1	1	1	1			
	CO3	3	2	3			1	1	1	1			
	CO4	3	2	3			1	1	1	1			
	CO5	3	2	3			1	1		1			
	CO6	3	2	3			1	1		1			
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Indian standard code (BIS) of practice for engineering drawing-General principle of presentation, Conventional representation of threaded parts, Springs, Gear and common features, Abbreviations and symbols use in technical drawings.

Tolerance- Types-Symbols used and representation on the drawing - Fit types, Selection for different application- Allowance, Interchangeability. Surface finish- Relation to the manufacturing processes- Types of representation on the drawing- Welding symbols.

Preparation of working drawing for given machine components:
Bolts, Screws, Studs, Nuts, Keys and Key-ways.

Preparation of simple assembly drawings:
Different types of cotter and knuckle joints.

Preparation of simple assembly drawing for following machine with part drawings given:
Screw jack, Plummer block, Connecting rod, Machine vice, Tail stock of lathe, Tool head of shaper, fuel injection pump for single cylinder engine, Stop valve.

TEXT BOOKS:

1. Bhatt, N.D. Machine Drawing- Charotar publishing House, 2000.

2. Gopala Krishnan, Machine Drawing- Subash publishers, 2001.

REFERENCES:

1. Narayana.K.L. Machine Drawing- New age publisher, 2006.

Course Coordinator **HOD**
R.Hariharan **Dr. K. Balasubramanian**

18MCAB305	CULTURAL- LEARNING AN ART FORM	L	T	P	C
	Total Contact Hours – 30	0	0	2	0
	Prerequisite – Nil				
	Course Coordinator Name & Department:-AICTE				

Learning an Art Form

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

Course Coordinator **HOD**

Dr. K. Balasubramanian

18MCAB306	**CULTURAL- INTANGIBLE CULTURAL HERITAGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	0
	Prerequisite – NIL				
	Course Coordinator Name & Department:-AICTE				

Intangible Cultural Heritage (Festivals, Food ways, Local Games)

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

- To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;
- To study and document the prevalent social practices and beliefs regarding traditional foods;
- To study and document the feasts on religious and social occasions of different communities;
- To identify and document the food items consumed by different communities and determine their nutritional values;
- To conduct chemical analysis of food ingredients;
- To identify and document the kitchen generated health ingredients used by different communities;
- To find out the uses of leftover food stuff of different communities;
- To develop hygienic food chart for people ailing and suffering from different metabolic disorders; andto develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PCME401	APPLIED THERMODYNAMICS	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Thermodynamics				
	Course Coordinator Name & Department:-Dr. D. Ravi, Department of Mechanical Engineering				

OBJECTIVES

- To learn about of I law for reacting systems and heating value of fuels
- To learn about gas and vapor cycles and their first law and second law efficiencies
- To understand about the properties of dry and wet air and the principles of psychrometry
- To learn about gas dynamics of air flow and steam through nozzles
- To learn the about reciprocating compressors with and without intercooling
- To analyze the performance of steam turbines

COURSE OUTCOMES (COs)

CO1	To explain the law of reacting systems and heating value of fuels
CO2	To illustrate energy conversion in various thermal devices
CO3	Analyze about reciprocating compressors with and without intercooling
CO4	Elaborate Gas dynamics of air flow and steam through nozzles
CO5	Understand phenomena occurring in high speed compressible flows
CO6	Estimate the performance of steam turbines using principle of psychrometry

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3											1
	CO2		2										
	CO3						1				3		
	CO4										3	2	1
	CO5												
	CO6							3			3		
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Unit-I **12**

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit-II **12**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles.

Unit-III **12**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Working principles, Simple impulse(De laval) turbine, Reaction turbine, Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Unit-IV **12**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables, Flow of steam and refrigerant through nozzle,supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

Unit-V **12**

Introduction to Psychrometry-Psychrometric chart- Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Simple calculations used in psychrometry,

TEXT BOOKS:

1. Domkundwar S-Thermal Engineering-Dhanpat Rai publishers,2000
2. Rajput R.K, Thermal Engineering, Dhanpat Rai publishers, 2008

REFERENCES:

1. Nag P.K, Basic & Applied Thermodynamics-Tata McGraw Hill, 2002
2. YunusA.Cengel-Thermodynamics-International Edition, 2006.
3.engg-ebook.blogspot.in › ... › r k rajput › sem 4 › thermal engineering

Course Coordinator **HOD**

Dr. D. Ravi **Dr. K. Balasubramanian**

U18BSMA401	**Numerical Methods**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Engineering Mathematics I & II				
	Course Coordinator Name & Department:-**Mr. P. Bathmanaban, Mrs. K. L. Rajashree&** Dept of Mathematics				

OBJECTIVES

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES (COs)

CO1	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO2	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO3	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Be exposed Taylor's series and Runge-Kutta methods to solve initial value problems of ODE
CO5	Student will be able to solve two dimensional Laplace, Poisson equations.
CO6	Apply one dimensional heat and wave equations of PDE in Engineering problems.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	2			3		1	2	1	1	2	3
	CO2	3	1		2	3	1		2			1	2
	CO3	3		2		3		1		1		1	2
	CO4	3	2			2				1			
	CO5	3	2	3	2	2	1			2	1	2	
	CO6	3		3		2				2	1		
3	Category	Basic Science											
4	Approval	47th Academic Council, July 2018											

UNIT 1SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 9+3 Hrs

Fixed Point Iteration methods - Newton-Raphson method and Regula-Falsi method for single variable-solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT 2 INTERPOLATION 9+3 Hrs

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT 3NUMERICAL DIFFERNTIATION AND INTEGRATION9+3 Hrs

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT 4 INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION9+3 Hrs

Single step methods- Taylor series, Euler and modified Euler methods, RungeKutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's -Bash forth predictor and corrector methods.

UNIT 5 BOUNDARY VALUE PROBLEMS FORORDINARY AND PARTIAL DIFFERENTIAL EQUATION 9+3 Hrs

Finite difference - solution of 2^{nd} order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods),Finite difference explicit method for one dimensional wave equation.

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5^{th} edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42^{nd}Edition, 2016.
3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005 .

REFERENCE BOOKS

1. Curtis F.Gerald. "Applied Numerical Analysis" 7thEdn. Pearson Education,
2. Dennis G.Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jones &Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company, 2^{nd} Edition 2010.

Course Coordinator
Mr. P. Bathmanaban
Mrs. K. L. Rajashree

HOD
Dr. K. Balasubramanian

U18PCME402	**STRENGTH OF MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Engineering Mechanics				
	Course Coordinator Name & Department:- Mr. R. Hariharan, Department of Mechanical Engineering				

OBJECTIVES

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

COURSE OUTCOMES (COs)

CO1	To recognize the deformation behavior of simple structures.
CO2	Determine the types of beams and shear force and bending moment diagrams.
CO3	Illustrate about moment of inertia and deflection of beam
CO4	Analyze stress behavior
CO5	To evaluatethe stresses and deformation of the various types of shafts
CO6	Design about thick and thin cylinders

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	E	f	G	h	i	j	k	l
2	CO1	3	3			3							3
	CO2					2					1		
	CO3			3		2					1		3
	CO4		2			2	2				1		
	CO5					2					1		
	CO6					2					1		1
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT-I **9+3**

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

UNIT-II

Beams and type's transverse loading on beams- shear force and bending moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

UNIT - III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

UNIT - IV

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

UNIT - V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure, column and struts, Euler's formula, limitations of Euler's formula.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials,TataMcGrawHill Publishing Co. Ltd., New Delhi 2005
3. Prabhu T. J. – Mechanics of Solids, 2009
4. Subramanian R, Strength of Materials, Oxford University Press, 2007.

Course Coordinator **HOD**

Mr. R. Hariharan **Dr. K. Balasubramanian**

U18PCME403	**MANUFACTURING TECHNOLOGY**	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite- MANUFACTURING PROCESSES				
	Course Coordinator Name & Department:- Dr. R. J. Golden Renjith Nimal **,** Department of Mechanical Engineering				

OBJECTIVES

- To provide knowledge on machines and related tools for manufacturing various components.
- To understand the relationship between process and system in manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

COURSE OUTCOMES (COs)

CO1	To get the knowledge of Jigs and Fixtures so as to describe the machine capability for variety of operations.
CO2	Students will be able to discuss and improve the gear manufacturing and finishing processes.
CO3	Classify and explain the working principle of different NTM processes and interpret their suitability for machining different materials.
CO4	Students will be able to memorize the basic concepts of high energy rate forming.
CO5	Students will be able to evaluate different molding and forming operations for plastic materials.
CO6	Students will be able to analyze the different manufacturing processesof metals as well as polymer products.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	E	f	g	h	i	j	k	l
2	CO1	3	3	3	3	3	2	2	1	2	2	3	3
	CO2	3		3	2	2		2	1		2		
	CO3	3		2		3		2		1	2		
	CO4	3				3		2		2			3
	CO5	3		3				3	1		2		
	CO6	3	2	3	2	2		3			3	2	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **10**

Tooling for conventional and non-conventional machining processes: Mould and die design,Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

UNIT II **10**

Gear manufacturing process: Gear milling, gear shaping, gear planning, gear hobbing, Gear broaching. stamping process, cold drawing process, rolling process, sintering process, gear finishing process - gear shaving, gear grinding, gear lapping, gear honing**.**

UNIT III **10**

Non-traditional machining techniques, classification. Abrasive jet machining, Electrical Discharge machining, E.D wire cutting, Electro chemical machining, Electron Beam

Machining, Laser Beam Machining, Ultrasonic Machining – process parameters, process capabilities, application.

UNIT IV **6**

High Energy Rate forming - Explosive forming, Electro hydraulic, Electro magnetic forming, Dynapack machine – process parameters, process capabilities, application**.**

UNIT V **9**

Plastics – Introduction, Types, Plastic Moulding - compression Moulding, transfer Moulding, injection Moulding, blow Moulding, film and sheet forming, thermo forming, reinforced plastic, laminated plastics.

TEXT BOOKS:

1. Degarmo, Black &Kohser, Materials and Processes in Manufacturing
2. HajraChowdary S.K. The Fundamentals of Work Shop Technology. Vol. I & II, Media Publishers, 1997
3. Kalpakjian and Schmid, Manufacturing processes for Engineering materials (5th Edition)-Pearson India, 2014
4. Sharma P.C, A Text Book of Production Technology, S.Chand& Company Ltd, New Delhi, 2007

REFERENCES:

1. Chapman W.A.J - Work shop technology, vol I,II& III, 1975, ELBS.
2. Rao P.N. Manufacturing Technology - Foundry Forging & Welding, TMH., New Delhi – 2009.
3. Roy. A.Lindberg, Processes and Material Manufacture, PHI, 1995
4. www.studynama.com/.../301-**Manufacturing-Technology**-1-lecture-notes.

Course Coordinator **HOD**

Dr. R. J. Golden Renjith Nimal **Dr. K. Balasubramanian**

U18PCME404	**INSTRUMENTATION AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Physics				
	Course Coordinator Name & Department:-**Mr. V. P. Durairaj ,** Department of Mechanical Engineering				

OBJECTIVE:

- To provide a basic knowledge about measurement systems and their components
- To learn about various sensors used for measurement of mechanical quantities
- To learn about system stability and control
- To integrate the measurement systems with the process for process monitoring and control

COURSE OUTCOMES (COs)

CO1	Develop the knowledge of basics of Measurements, Metrology and Measuring instruments.
CO2	Improve the competence in sensors, transducers and terminating devices with associated parameters.
CO3	Discuss the various devices for measuring torque, force, strain, stress and temperature.
CO4	Describe the various advanced measuring devices and laser metrology.
CO5	Determine the advancements in the control system.
CO6	Demonstrate the ability to analyze the results of various measuring systems and instruments to give better conclusions.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	3		2							2	
	CO2				2	3				1		
	CO3	1	3			3			2			
	CO4	2			2							3
	CO5			2	2	1				3		
	CO6	1			3						2	
	Category	Professional Core										
4	Approval	47th Academic Council, July 2018										

UNIT – I **10**

Generalized measuring system - Limits, fits and tolerances; Limit Gauges and Slip Gauges, linear and angular measurements; comparators; Interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly, Auto collimator – Angle Dekkor.

UNIT – II **9**

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors and transducers for common engineering measurements; Signal processing and conditioning; correction elements

UNIT – III **9**

Form measurement – Measurement of tooth thickness – gear tooth Vernier – Surface finish measurement – radius measurement – flatness and roundness measurement – Screw thread and gear Measurement.Laser Metrology: Precision instrument based on laser – Principle – Application of laser – Laser interferometer – Applications in linear measurement and angular measurement.

UNIT – IV **8**

Coordinate Measuring Machine – constructional features – types – Applications of CMM – CNC. CMM applications – Inspection by computer aided – machine vision – Applications in Metrology.

Force measurement – Torque measurement – Pressure measurement – Temperature measurement – Vibration Measurement.

UNIT – V **9**

Actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

TEXT BOOKS:

1. Instrumentation and control systems by W. Bolton, 2nd Edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York, 1999.
4. R.K.Jain Engineering Metrology , Khanna Publishers, 2005

REFERENCES:

1. Kumar D.S Mechanical Measurement and Control – Metropolitan Book company Pvt. Ltd. – 1989.
2. T.G.Beckwith and N.Lewis Buck, Mechanical Measurements, Addison Wesley, 2001
3. Sirohi, R.S. and Radhakrishnan, H.C.Mechanical Measurements, New Age, 1994.

Course Coordinator **HOD**

Mr. V. P. Durairaj **Dr. K. Balasubramanian**

U18PCME405	THEORY OF MACHINES	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite –Engineering Mechanics				
	Course Coordinator Name & Department:- **Dr. R. J. Golden Renjith Nimal,** Department of Mechanical Engineering				

OBJECTIVES

- To understand the kinematics and rigid- body dynamics of kinematically driven machine components
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
- To be able to design some linkage mechanisms and cam systems to generate specified output motion
- To understand the kinematics of gear trains

COURSE OUTCOMES (COs)	
CO1	Discuss the basic concepts of various mechanisms.
CO2	Examine the velocity and acceleration diagram for a given mechanism.
CO3	Discover the effects of friction in mechanical element.
CO4	Design cams and followers for specified motion profiles.
CO5	Determine the static and dynamic balancing calculations for rotating and reciprocating masses.
CO6	Evaluate the important types of vibrations and acquire knowledge in the calculation of natural frequency.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	2	1	3		3			2	1		2	3
	CO2	1		3	2	1		2	1			2	2
	CO3	3	2	3	2		1	2	3	1		3	
	CO4		3	2		2		1	3			2	
	CO5	3	2	3	1	3		2	2			3	1
	CO6	3	3	2	1	2			3			1	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **12**

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT II **12**

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT III **12**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT IV **12**

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method

UNIT V **12**

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

TEXT BOOKS

1. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.
2. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co, New Delhi,2004.

REFERENCES

1. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.
2. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
3. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
4. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, WileyEastern Ltd., 1992.
5. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.

Course Coordinator **HOD**

Dr. K. Balasubramanian

Dr. R. J. Golden Renjith Nimal

U18MCTH 401	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	0	0	0
	Prerequisite – Professional Courses				
	Course Coordinator Name & Department:- Department of Management studies				

OBJECTIVES

To know about Indian constitution. To know about central and state government functionalities in India. To know about Indian society.

COURSE OUTCOMES (COs)	
CO1	To understand the historical background and fundamental rights
CO2	To understand the structure and functions of governments
CO3	To understand the Indian social structure
CO4	To gain knowledge in Indian federal system
CO5	To gain knowledge Indian social structure
CO6	To gain knowledge the right of women, children and SC&ST

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	1		3									
	CO2					3			2	1			
	CO3	1					3			1			
	CO4							2		1			
	CO5	1					2		2				
	CO6												
	Category	Mandatory Course											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II 9

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III 9

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV 9

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V 9

Society : Nature, Meaning and definition; Indian Social Structure; Castle, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TEXT BOOKS:

1. Agarwal R.C., " (1997) Indian Political System ", S.Chand and Company, New Delhi.
2. Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

REFERENCES:

1. Gahai U.R, "(1998) Indian Political System ", New Academic Publishing House, Jalaendhar.
2. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
3. Sharma K.L, " (1997) Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi.
4. Sharma R.N., "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.
5. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
6. Yogendra Singh, "(1997) Social Stratification and Charge in India ", Manohar, New Delhi
7. www.cgsird.gov.in/**constitution.pdf**

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PCME4L1	**STRENGTH OF MATERIALS AND FLUID MECHANICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours –30	**0**	**0**	**2**	**1**
	Prerequisite – Engineering Mechanics				
	Course Coordinator Name & Department:- Mr. Arun V.Rejus Department of Mechanical Engineering				

OBJECTIVES

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

COURSE OUTCOMES (COs)

CO1	Students will understand flow through pipes
CO2	Students will practically understand different flow measuring equipment.
CO3	Student will understand the strength of components and testing methods.
CO4	Student will understand the characteristics of pumps.
CO5	Students study the importance of flow analysis
CO6	Students learn deflection and stresses

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	2	3	2	1						1	2	
	CO2	2	3	2	1						1	2	
	CO3	2	3	2	1						1	2	
	CO4	2	3	2	1						1	2	
	CO5	2	3	2	1						1	2	
	CO6	2	3	2	1						1	2	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

LIST OF EXPERIMENTS

FLUID MECHANICS LAB

1. Determination of flow through pipes, losses in pipes.
2. Calibration of orificemeter and venture meter
3. Flow through notches and weir
4. Flow through open orifice
5. Buoyancy experiment-Metacentric height.
6. Impact of jet on vanes-inclined and curved vanes
7. Verification of Bernoulli's equation

FLUID MACHINERY LAB

1. Performance characteristics of Jet pump
2. Performance characteristics of Vane pump
3. Performance characteristics of Centrifugal pump
4. Performance characteristics of Reciprocating pump
5. Performance characteristics of Gear pump
6. Characteristics of Impulse turbine

7. Characteristics of Reaction turbine

STRENGTH OF MATERIALS LAB

1. Tension test of a mild steel rod
2. Double shear test on mild steel and Aluminum rods
3. Torsion test on mild steel rod
4. Hardness test on metals- Brinell and Rockwell hardness
5. Deflection test on helical springs
6. Deflection test on beams
7. Compression test – bricks
8. Double shear test in U.T.M

Course Coordinator **HOD**

Dr. K. Balasubramanian

Mr. Arun V.Rejus

U18PCME4L2	METROLOGY & METALLURGY LAB	L	T	P	C
	Total Contact Hours –30	0	0	2	1
	Prerequisite – Metrology				
	Course Coordinator Name & Department:- Mrs.G.Sucharitha, Department of Mechanical Engineering				

OBJECTIVES

- To get an idea of the dimensional & form accuracy of products.

COURSE OUTCOMES (COs)	
CO1	Students will understand the difference between accuracy and precision
CO2	Students will be able to identify the different measuring equipments .
CO3	Student will have the knowledge to make a use of metallurgicalmicroscope.
CO4	Student will learn to analyze metallographic structures of different materials.
CO5	Student will be able to explain the crystallographic structures of different materials.
CO6	Students will be able to discuss about the profile of a gear.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	F	g	h	i	j	K	L
2	CO1	3											
	CO2		3										1
	CO3									3			
	CO4										1		
	CO5				2							1	
	CO6							2					
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

LIST OF EXPERIMENTS:

METROLOGY LABORATORY

1. Calibration of dial gauge, micrometer and vernier.
2. Measurement using Precision Measuring Instrument like verniercaliper,Micrometer,dialcauge,Vernier height Gauge
3. Measurement of angles using sine bar, bevel protractors, sine centre
4. Use of Tool Maker's Microscope
5. Volume and Area Measurement for the given block using slip gauge.
6. Bore diameter measurement using micrometer and telescopic gauge

METALLURGY LABORATORY

1. Study of metallurgical microscope
2. Preparation of specimen for metallographic observation of white Cast Iron, Grey Cast Iron, Malleable Iron.
3. Preparation of specimen for metallographic observation of Mild Steel, Low CarbonSteel, Medium Carbon Steel, Tool Steel, High speed Steel, and Stainless steel.
4. Preparation of specimen for metallographic observation of Copper-bronze, Copper brass.
5. Microscopic examination of heat-treated and untreated metallic samples

Course Coordinator **HOD**

Mrs.G.Sucharitha **Dr. K. Balasubramanian**

U18MCAB407	**LITERATURE & MEDIA – LITERATURE ,CINEMA& MEDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Coordinator Name & Department:-AICTE				

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. DescriptionLiterature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not justthe literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18MCAB408	**LITERATURE & MEDIA – GROUP READING OF CLASSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Coordinator Name & Department:-AICTE				

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PCME501	**HEAT TRANSFER**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Thermal Engineering-II				
	Course coordinator Name & Department – Mr.J. Manikandan, Department of Mechanical Engineering				

OBJECTIVES

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students can able to understand different heat and mass transfer principles
CO2	Students exhibit memory of the principles of conduction
CO3	Students are able to presentthe principles of convection
CO4	Students solve problems in new situations by applying acquired knowledge for the welfare of the people
CO5	Students will have the knowledge of examining the radiation concepts in heat and mass transfer
CO6	Students are able to present and defend opinions by making judgments about steady state and unsteady state of systems

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3	2					2			2		3
	CO2	3							1		2		
	CO3	3							1		2		3
	CO4											1	2
	CO5							2					
	CO6					2							1
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Unit –I **14**

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit-II **14**

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to

laminar boundary layer equations (momentum and energy) for both internal and external flow. Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit-III **10**

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve

Unit-IV **12**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Unit-V **10**

Introduction mass transfer, Fick's law of diffusion, Stefan's law, Mass transfer co-efficient, Non-dimensional number used in mass transfer, evaporation process in the atmosphere. Similarity between heat and mass transfer.

Total number of hours (40 lectures + 12 tutorials)

TEXT BOOKS:

1. Nag P.K, Heat transfer, McGraw Hill Book Company,2002.
2. Sachdeva.R.C-Fundamentals of Heat&Mass Transfer-NewAgeInternational(P)Ltd, 2003
3. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

REFERENCES:

1. Dr.D.S.Kumar,Heat and Mass Transfer,S.K.Kataria& sons,2003
2. Holman.J.P-heat transfer –McGraw hill Book Company, 2002
3. OzisikN.M-heat transfer-McGraw hill Book Company, 1985
4. **book**boon.com/en/momentum-**heat-and-mass-transfer-ebook**

Course Coordinator **HOD**

Mr.J. Manikandan **Dr. K. Balasubramanian**

U18PCME502	**COMPUTER AIDED DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course coordinator Name & Department – Dr.S.Thirumavalavan Department of Mechanical Engineering				

OBJECTIVES

This course will enable the student To gain knowledge about the basic fundamentals of CAD.

COURSE OUTCOMES (COs)

CO1	To Remember how computers are integrated at various levels of planning, manufacturing and computer aided planning and monitoring.
CO2	Understand the concepts of CAD Algorithm
CO3	To apply the knowledge of various curves in CAD
CO4	To analyze the basics of CAM
CO5	To create Part Programming in CAM
CO6	To understand the 2D , 3D and Part Programming

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	G	h	i	j	k	l
2	CO1	3	3							2			
	CO2												
	CO3			3			3	2	2				3
	CO4				3						2	2	
	CO5												
	CO6												3
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Principles of Computer hardware, Software and Operating System, Data Handling and File Structures, Computer aid in Phases of design- CAD standards- Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards

Elements of CAD Systems, Introduction to Graphic Hardware, Software, Details of 2D Software Packages-Layering, Drawing Primitives, Display Techniques, Editing, utilities, Scaling, Dimensioning, 3D Visualization, Geometric Modeling-Wireframe and Solid models.

UNIT II **9**

Hidden Line – Surface - Solid removal algorithms – shading – colouring – computer animation.Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interefence checking

UNIT III **9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.

UNIT IV **9**

Numerical Control- Modes- NC Elements- NC Machine Tools- CNC Machines- CNC Hardware Basics- CNC Tooling- CNC Machine Tools and Control System- Part Programming- Manual part programming & Types- G-Codes and M-Codes.

UNIT V **9**

Advanced Part Programming- Direct Numerical Control- Adaptive Control Computer Aided Part Programming, APT, Canned Cycle, Offset, Simple CNC programs

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

REFERENCES:

1. Chris McMahon and Jimmy Browne, CAD/CAM, Pearson Education, 2001.
2. Mikell P.Groover, Automation, Production Systems and CIM, II Edition, Prentice Hall of India, 2001.
3. Radhakrishnan P. CAD/CAM/CIM, I Edition, New central Book Agency, 2006.
4. Rao P.N. CAD/CAM, Principles and Application, Tata McGraw Hill, 2005.

Course Coordinator **HOD**

Dr.S.Thirumavalavan **Dr. K. Balasubramanian**

	MACHINE DESIGN - I	L	T	P	C
U18PCME503	Total Contact Hours - 60	3	1	0	4
	Prerequisite – ENGINEERING MECHANICS				
	Course coordinator Name & Department – Dr.V.Balambica Department of Mechanical Engineering				

OBJECTIVES

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice.

COURSE OUTCOMES (COs)

CO1	Students will be able to learn the concepts and behavior of machine components failure criteria based on suitable material selection.
CO2	Student will have an understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
CO3	Students will have an overview of codes, standards and design guidelines for different elements
CO4	Students will have the knowledge of parametric optimization and design iteration
CO5	Students will recognize the relationships between component level design and overall machine -system design performance
CO6	Upon completion of this course, students will be able to improve design methodologies and provide alternative solutions.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3	3	1					2	2		3	3
	CO2	3	3	1									
	CO3											3	
	CO4			1									1
	CO5			2						2		2	
	CO6		3	3					2	2		3	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I FUNDAMENTALS 12

Design process – Engineering Materials and Mechanical properties – Design Considerations: Limits, Fits and Tolerances – Principal stresses — Calculation of permissible stress – Failure theories(Static and Dynamic) including fatigue failure – Stress Concentration .

UNIT II DESIGN OF SHAFTS 12

Design of Shafts under Static and Fatigue loading – Shafts carrying Pulleys, Gears – Simply Supported Shafts - Hollow shafts.

UNIT III DESIGN OF HELICAL & LEAF SPRINGS 12

Design of Tension, Torsional and Compression Helical springs and Leaf springs – Springs for Buffers – Springs for Impact loads.

UNIT IV DESIGN OF BEARINGS 12

Design of sliding contact bearings using Somerfield number - Selection of Rolling contact bearings for Radial and Axial load combination .

UNIT V DESIGN OF JOINTS & COUPLINGS 12

Design of Joints –-Bolted and Welded joints -Screw fasteners –Analysis and Application of Power Screws– Design of Couplings: Muff coupling -Flange Coupling & Clamp coupling.

TEXT BOOKS :

1. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
2 Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International;1989.

REFERENCES :

1. Bhandari V.B – Design of Machine Elements – TataMcGraw Hill, 2007.
2. Design Data, PSG College of Technology, 2007.
3. Dobrovolosky, Machine Elements – Mir Publications, 1978.
4. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
5. Norton R. L, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
6. Pandya & Shah – Elements of Machine Design, 2000.
7. Prabhu T.J. – Fundamentals of Machine Design, 2009.
8. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
9. www.allexamresults.net/.../download-pdf-textbook-of-**thermal-engineering**

Course Coordinator **HOD**

Dr. K. Balasubramanian

Dr.V.Balambica

U18HSBA401	**ORGANIZATIONAL BEHAVIOR**	L	T	P	C
	Total No. of contact hours: 45	3	0	0	3
	Pre-requisite:				
	Course coordinator Name & Department –Dept of Management Studies				

Course Objectives

1. Understanding the basic approaches in organization
2. Knowledge on theories of Personality
3. Clear sight on the Decision Making in Groups
4. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour.

COURSE OUTCOMES (COs)

CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour
CO2	Knowledge of the Interpersonal perception
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Familiarity with the knowledge of types of Conflicts
CO6	

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1				3								
	CO2				3			3		3			
	CO3				3								
	CO4										3		
	CO5										3		
	CO6												
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Unit I **9**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

Unit II **9**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

Unit III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

Unit IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

Unit V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

REFERENCES

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PCME5L1	**THERMAL AND HEAT TRANSFER ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Thermal Engineering, Thermodynamics				
	Course coordinator Name & Department – Mr.J.Manikandan, Department of Mechanical Engineering				

OBJECTIVES

- To practically understand the concepts and working of various thermal application like IC engines, Compressors and Refrigeration and Air conditioning systems
- To practically understand the concepts and working of various Heat transfer application like Conduction, convection and radiation systems

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students can able to understand the fundamentals in every area of thermal engineering.
CO2	Will improve the knowledge regarding the concepts in thermal and heat transfer lab
CO3	Students are able to presentthe working principle of Thermal Equipments
CO4	Students can examine the working principle of IC Engines
CO5	Students are able to presentthe concept and working of compressors
CO6	Students are able to compilethe working principle of Heat transfer equipments

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3											
	CO2		3										
	CO3									3			
	CO4										1		
	CO5				2							1	
	CO6							2					
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

Contents:

Thermal Lab

Determination of viscosity using Saybolt and Redwood viscometer
Valve timing diagram of a four stroke engine, Port timing diagram of a two stroke engine
Determination of mechanical efficiency of four stroke diesel engine
Heat balance test on a four stroke diesel engine
Performance test on a multi cylinder petrol engine- Morse test
Test on Air compressor
Performance test on a Refrigeration plant
Performance test on A/C plant

Heat Transfer Lab

Thermal conductivity of insulating materials
Thermal conductivity of guarded hot plate method
Heat transfer through composite wall
Heat transfer by free and forced convection
Test on heat exchangers- parallel and counter flow
Emissivity measurement apparatus
Stefan-Boltzman apparatus
Test on Pin fin apparatus

Course Coordinator **HOD**

Mr.J.Manikandan **Dr. K. Balasubramanian**

	INSTRUMENTATION AND DYNAMICS LAB	L	T	P	C
U18PCME5L2	Total Contact Hours –30	0	0	2	1
	Prerequisite – Instrumentation and Control				
	Course coordinator Name & Department – Dr. R. J Golden Renjith Nimal Department of Mechanical Engineering				

OBJECTIVES

- To understand the measurement of mechanical properties of materials
- To understand the deformation behaviour of materials
- To understand the kinematic and dynamic characteristics of mechanical devices
- To understand how certain measuring devices are used for dynamic testing.

COURSE OUTCOMES (COs)

CO1	Recall the concepts in kinematics and Dynamics of Machinery
CO2	Describe the various measuring devices are used for dynamic testing.
CO3	Improve knowledge regarding various types of forces and reactions.
CO4	Determine the natural frequency of various types of vibrations.
CO5	Demonstrate the balancing of rotors and develop the knowledge to use tachometer.
CO6	Analyze the forces acting on machines and mechanisms for specific applications such as, cams, gears and balancing.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	F	g	h	i	j	k	L
2	CO1	3								2			
	CO2											3	
	CO3									2			
	CO4								1				
	CO5			2									
	CO6					3				2			
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

LIST OF EXPERIMENTS:

INSTRUMENTATION

1. Pressure measuring device calibrations
2. Force measurement load cell, providing ring
3. Temperature measuring devices: Thermocouple, Platinum resistance thermometer.
4. Speed measurement: Tachometer & Stroboscope
5. Torque measurement
6. Flow measurement: Orifice meter, Rotometer.
7. Vibration measurement.

DYNAMICS LAB

1. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
2. Cam & follower and motion studies
3. Kinematics of gear trains – Simple, Compound, Epicyclic
4. Determination of M.O.I by using connecting rod and flywheel
5. Governors – Watt, Porter
6. Motorized gyroscope and verification of losses
7. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient
8. Determination of M.O.I using compound pendulum.
9. Determination of stiffness and natural frequency of single rotor and two rotor shafts.
10. Determination of critical speed of shaft with concentrated loads- Whirling of shafts.
11. Balancing of rotors.

Course Coordinator **HOD**

Dr. K. Balasubramanian

	MANUFACTURING TECHNOLOGY LAB	L	T	P	C
U18PCME5L3	Total Contact Hours- 30	0	0	2	1
	Prerequisite – Manufacturing Technology				
	Course coordinator Name & Department – R.Hariharan , Department of Mechanical Engineering				

OBJECTIVES

- To provide an understanding of advanced manufacturing methods.
- To get an idea of the dimensional & form accuracy of products
- To expose students in understanding various metal cutting operations and commonly used machine tools.

COURSE OUTCOMES (COs)

CO1	recognize lathe and its working
CO2	To aware about different tools used in manufacturing.
CO3	Understand the concept of tool wear.
CO4	Distinguish the functions and applications of different metal cutting tools
CO5	To formulate different methods of manufacturing
CO6	To create how to learn force calculations

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3								2		3	
	CO2											3	
	CO3									2			
	CO4												
	CO5											3	
	CO6			2		3				2			
3	Category	Professional core											
4	Approval	47th Academic Council, July 2018											

LIST OF EXPERIMENTS:

1. Exercise on Plain turning and thread cutting
2. Taper turning and knurling using lathe
3. Contour milling using vertical milling machine
4. Spur gear cutting in milling machine
5. Helical Gear cutting using Hobbing machine
6. Determination of cutting forces in Milling and drilling using dynamometers
7. Slotting and key way cutting in vertical slotting machine
8. Shaper Exercise : Making a square from a round rod
9. Exercise on drilling and boring
10. Surface Grinding

Course Coordinator **HOD**

U18MCAB611	**SELF DEVELOPMENT –SPRIRITUAL, MINDFULNESS & MEDITATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Spiritual, Mindfulness and Meditation

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness.

The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta - cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more)
Sessions: multiple 10-day sessions may be organized over a semester.

U18MCAB612	**SELF DEVELOPMENT – RELIGION AND INTER -FAITH**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under 'book reading'.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

U18PCME601	**MACHINE DESIGN II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Machine design I				
	Course coordinator Name & Department – Mr. V.Jose Ananth Vino Department of Mechanical Engineering				

OBJECTIVES

To learn about the design procedures for mechanical power transmission components.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students will understand the basic design aspects associated with different types of clutches and brakes.
CO2	Students will be able to do analysis of flexible power transmission drives and can design and recommend best flexible power transmission drives for any types of machines
CO3	Students will understand Design principles associated with different types of gears
CO4	Students will apply the design knowledge for recommending the required types, size and shape of gears required in any machines.
CO5	Students can evaluate gear box for automobiles and machine tools.
CO6	Students can create single plate clutch ,multi plate clutch and gears .

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3	3	1						3		3	3
	CO2	3	3	1					2			3	
	CO3	3	3							2		3	
	CO4	3	2	2					2			3	2
	CO5	2	2	2								2	
	CO6	2	3	3					2			3	
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT I **12**

Design of Plate Clutches, Axial Clutches, Cone Clutches, Internal Expanding Rim Clutches; Electromagnetic Clutches; Band and Block brakes, External Shoe Brakes, Internal Expanding Shoe Brake.

UNIT II **12**

Design of Flexible Transmission drives using manufacturer's data. Design of Flat Belts & Pulleys, Selection of V-belts and pulleys, Selection of Hoisting Wire ropes and pulleys, Design of Chains and Sprockets

UNIT III **12**

Gear Materials- Force Analysis-Design of Spur and Helical gears – Cross Helical Gears, Terminology, Helix angles, Sizing of a pair of Helical gears.

UNIT IV **12**

Straight Bevel gear- Tooth Terminology, Tooth Forces and Stresses, Equivalent Number of teeth. .Estimating the Dimensions of a pair of Straight Bevel gears; Worm gear, Merits &Demerits, Terminology, Materials, Forces & Stresses, Efficiency, Estimating the size of Worm Gear Pair.

UNIT V **12**

Gear box- Geometric progression, Standard step ratio; Ray diagram, Kinematics layout; Design of Sliding Mesh, Constant mesh, Synchromesh Gear Box- Design of Multi-Speed Gear Box for Machine Tool Applications. Calculation of Number of teeth in Gears- Speed Reducer Unit; Variable Speed Gear Box.

TEXT BOOKS :

1. Prabhu T.J. Design of Transmission Elements, 2008.
2. Shigley, Mechanical Engineering Design – Tata McGrawHill,2004.

REFERENCES :

1. Dobrovolosky, Machine Elements – Mir Publications, 1978.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.
4. Pandya & Shah – Elements of Machine Design, 2000
5. www.faadooengineers.com/.../26687-**Machine-design**-by-shigley-**ebook**
6. **Design data book compilled by PSG college of Technology.**

Course Coordinator **HOD**

V. Jose Ananth Vino **Dr. K. Balasubramanian**

U18PCME602	**FINITE ELEMENT ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	0	0	4
	Prerequisite – Numerical Methods				
	Course coordinator Name & Department – Dr.C.M.Meenakshi Department of Mechanical Engineering				

OBJECTIVES

This course will enable the student To gain knowledge about the basic fundamentals of CAD.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students will able to recognize different mathematical Techniques used in FEM analysis
CO2	Understand the concepts of Nodes and elements
CO3	Students will able to apply FEA in Structural and thermal problem
CO4	Students will able analyze heat transfer problem using FEA technique
CO5	Students will able to classify the types of analysis and its application
CO6	Students will able to build a FEA Model

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3	2					2			2		3
	CO2	3							1		2		
	CO3	3							1		2		
	CO4											1	
	CO5							2					3
	CO6					2							
3	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

UNIT -1 **9**

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

UNIT –II **9 HRS**

One dimensional second order equation, Bar element – Mechanical and Thermal loads discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, longitudinal vibration and mode shapes

UNIT -1II **9 HRS**

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices application to thermal problems, torsion of non-circular shafts. Plane stresses and plane strain problems.Trusses and Frames.

UNIT -1V **9 HRS**

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, Choice of quadrature rule – Gauss Point -matrix solution techniques, solution of dynamic problems

UNIT – V **9 HRS**

Introduction to FE software.Computerized FEA – Preprocessing –Element types - Mesh generation – Solution – Post processing – Procedures of Case studies.

TEXT BOOKS:

1. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
2. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
3. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.

REFERENCES:

1. Bathe K.J – Finite Element Procedure – Prentice Hall of India, 1996.
2. Bhavikati S.S – Finite Element Analysis, New Age International Publishers.
3. ChandraputlaT.R ,A.D.Belegundu – Introduction to Finite Elements in Engineering – Prentice Hall of India, 2002
4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall,1990
5. https://www.amazon.in/...**FINITE-ELEMENT-ANALYSIS**...**ebook**/.../B0
6. Zienkiewicz O.C–The Finite Element Method in Engineering Science, McGrawHill, 2000.

Course Coordinator **HOD**

Dr.C.M.Meenakshi **Dr. K. Balasubramanian**

U18BSMA601	**OPERATIONAL RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	0	0	3
	Course coordinator Name & Department – Department of Mechanical Engineering				

OBJECTIVES

To provide the student with the concept and an understanding of basic concepts in Linear Programming techniques, Duality Principles, Transportation and Assignment problems, Inventory models, PERT/CPM, Queuing and Replacement Models.

COURSE OUTCOMES (COs)

CO1	Explain the basic concepts of optimization and to formulate and solve linear programming problems, Apply duality principle in day to day life style
CO2	Apply the concepts of Transportation Problem and Assignment Problem, Participate in the class room discussion on Transportation algorithm.
CO3	Explain and Demonstrate the basic concepts of PERT- CPM and their application reproduce the network model.
CO4	Explain the basic concepts of optimization and to formulate and solve inventory problems.
CO5	Explain and apply the concepts of Queueing theory and their application
CO6	Explain and apply the concepts of sequencing problem and its applications

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3	3	2		3		1				3	
	CO2	3	3						2	3		3	l
	CO3		3		2	2				3	2	3	
	CO4	2		3		2	1		3			3	
	CO5		2	3	3	1					3		
	CO6		2		3	1					3		
	Category	Humanity science											
4	Approval	47th Academic Council, July 2018											

UNIT I LINEAR PROGRAMMING 12Hrs

Introduction to phases of an Operations Research study– Linear programming – Formulation of the Programming – Graphical method – Simplex method – Dual simplex method-Two phase method.

UNIT IITRANSPORTATION &ASSIGNMENT PROBLEMS12Hrs

Transportation models – Vogel's approximation method Modi method – Unbalanced transportation problem – Degeneracy in transportation models - Assignment problems – Hungarian method

UNIT III NETWORKS & REPLACEMENT MODELS 12Hrs

Networks – PERT and CPM – Network diagrams – Shortest route – Minimum spanning tree,Replacement models– Individual and Group replacement policy

UNIT IV INVENTORY MODELS 12Hrs

Inventory models– Deterministic models– Production models – Economic Ordering Quantity Models – Quantity Discount Model –Multi Product Models – Inventory Control Models in practice.

UNIT VQUEUEING MODELS&RESOURCE SCHEDULING 12Hrs

Queuing theory – Queuing system and structure – Kendal's notation– Poisson arrival and Exponential service time – Characteristic of queuing models – Single channel and Multiple models.Resource scheduling – Sequencing n jobs through 2 machines and 3 machines.

Text Books /References:

1. Gupta and Hira D.S " Operations Research", S. Chand & Co, New Delhi, 2006
2. Kanti Swarup, Gupta, P.K and Manmohan, "Operations Research", Sultan Chand & Sons 1997
3. Paneerselvam, R, Operations research, Prentice-Hall of India, New Delhi, 2001.
4. Taha H.A, "Operations Research", Prentice Hall of India, 2002, Seventh Edition 2007.

Course Coordinator **HOD**

Dr. K. Balasubramanian

	CAD/CAM LABORATORY	L	T	P	C
U18PCME6L1	Total Contact Hours –30	0	0	2	1
	Prerequisite – CAD /CAM/CIM				
	Course coordinator Name & Department – Mr.Srinivasan Department of Mechanical Engineering				

OBJECTIVES

This course will enable the student To gain knowledge about the basic fundamental of CAD and CAM

COURSE OUTCOMES (COs)

CO1	Understand the benefits of computer aided design
CO2	Students remember and learn the Knowledge of CNC.
CO3	Understand the computer aided manufacturing of machine elements.
CO4	**Students analyze 2D modeling**
CO5	Students apply and solve 3d Drawings
CO6	Remember to learn writing commands

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3							2			1	3
	CO2	3							2			1	
	CO3			3	3	3						1	3
	CO4					2						1	3
	CO5					2							
	CO6						2	2	2				
3	Category	Professional core											
4	Approval	47th Academic Council, July 2018											

CAD Introduction to Computer Aided Drawing

2-D DRAWING Orthographic Views, Isometric Views, 2D Sectional Views, Part Drawing, Assembly Drawing, Detailed Drawing. Dimensioning, Annotations, Symbols, Welding, Surface finish, Threads, Text, Bill of Materials. Exercise- Knuckle Joint, Gib and Jotter Joint, Screw Jack, Foot Step Bearing.

3-D DRAWING Part Modeling- Protrusion, Cut, Sweep, Draft and Loft- Modify/Edit- Pattern- Transformation, Boolean operation. Assembly- Creating Assembly from Parts, Modify/Edit- Pattern Conversion of 3D Solid Model to 2D Model. Surface Modeling- Tabulated, Revolve, Ruled and Edge Surfaces. Exercise- Piston, Connecting Rod, Knuckle Joint, Universal Joint, Couplings.

CAM LAB

1. Manual Part programming for CNC machines Using standard G – Codes and M- codes. Simulation of Tool path – Machining Practices on Trainer type CNC Machines – Straight cut, Taper turning, Profile, Parting, Thread cutting.
2. CNC Milling Machine: Production of Various Contour shapes
3. Computer assisted part programming – APT programming Language – Part programming

using APT and other NC programming Languages.

4. Introduction to Component Modeling
5. NC code generation using CAD / CAM software – Post processing for standard CNC controls like FANUC, SINUMERIC etc.,

Course Coordinator **HOD**

Mr.Srinivasan

Dr. K. Balasubramanian

	SOFT SKILL LAB	L	T	P	C
U18EEEA6L2	Total Contact Hours –30	0	0	2	1
	Prerequisite – CAD /CAM/CIM				
	Course Designed by – Department of English				

OBJECTIVES

Develop their communicative competence in English with specific reference to speaking and listening

COURSE OUTCOMES (COs)

CO1	Develop their communicative competence in English with specific reference to speaking and listening
CO2	Enhance their ability to communicate effectively and efficiently in interviews.
CO3	Strengthen their prospects of success in competitive examinations.
CO4	Work with peer group in a smooth manner.
CO5	Develop inter personal and intra personal skills
CO6	Develop their communicative competence in English with specific reference to speaking and listening

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1												
	CO2							3					
	CO3												
	CO4				3								
	CO5				2								
	CO6												
3	Category	Humanity Science											
4	Approval	47th Academic Council, July 2018											

UNIT I LISTENING AND SPEAKING SKILLS 6 hours

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio.

UNIT II READING AND WRITING SKILLS 6 hours

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports.Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 6 hours

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

UNIT IV INTERVIEW SKILLS 6 hours

Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.

UNIT V SOFT SKILLS 6 hours

Motivation- emotional intelligence-Multiple intelligences-managing changes-time management-stress management-leadership traits-team work- career planning -intercultural communication- creative and critical thinking

To be totally learner-centric with minimum teacher intervention as the course revolves around practice.

1. Suitable audio/video samples from YouTube to be used for illustrative purposes.
2. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
3. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

REFERENCES:

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth , Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2013.
4. Evans, D, **Decision maker**, Cambridge University Press, 2010.

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18EEME6L3	**SUMMER INERNSHIP**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	0	1
	Prerequisite –				
	Course Designed by – Dr. K. Balasubramanian Department of Mechanical Engineering				

OBJECTIVES

Develop their communicative competence in English with specific reference to speaking and listening

COURSE OUTCOMES (COs)

CO1	Recognize the importance and opportunities for the development of skills.
CO2	Select the appropriate training and experiential learning methodologies.
CO3	Strengthen their potential in diversified but essential activities like counselling, assessment, outreach, and provision of supervision and enhance the prospects of success in technological world.
CO4	Outline the importance of work with peer group and to enhance their amicability.
CO5	Recommend an open and supportive environment conducive to the development of multicultural competence.
CO6	Make use of the prescribed regulations to built the continuous assessment report

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1												
	CO2							3					
	CO3												
	CO4				3				2				
	CO5				2						2		
	CO6												
3	Category	Humanity Science											
4	Approval	47th Academic Council, July 2018											

Industrial / Practical Training / Internship / Mini Project

The Industrial / Practical Training shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of Industrial / Practical training / internship / Summer Project, the student shall submit a brief report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department.

Course Coordinator **HOD**

Dr. K. Balasubramanian **Dr. K. Balasubramanian**

18MCAB509	**SOCIAL SERVICES – SOCIAL AWARENESS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social awareness (Artisans-relates to engg., visit to hospitals, orphanages, policestation, courts, trauma centers, consumer forums)

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in *BanarasiSaari*, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of actions.

18MCAB510	**SOCIAL SERVICES – NSS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social Service (teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer**)**

U18PCME701	**AUTOMATION IN MANUFACTURING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Manufacturing Technology, CAD/CAM				
	Course coordinator Name & Department – Mr.Lenin Rakesh Department of Mechanical Engineering				

OBJECTIVES

- To understand the importance of automation in the of field machine tool based manufacturing
- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
- To understand the basics of product design and the role of manufacturing automation

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the Students can able to remember the computer based automation of manufacturing operations
CO2	Students are able to learn and understand the fundamentals of CAD
CO3	Learn and analyze about the New Product Development and Optimization
CO4	Students remember the fundamentals of CNC and CNC Programming
CO5	Understand the Electronics in Mechanical systems and Flexible automation
CO6	Students are able to create a new level of manufacturing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	B	C	D	e	f	G	h	i	j	K	l
2	CO1	3				3					2		3
	CO2					1					2		
	CO3		3	3							2	3	
	CO4	2			3						2	3	
	CO5			2	3						2	3	1
	CO6			2							2	3	
3	Category	Professional core											
4	Approval	47th Academic Council, July 2018											

UNIT I **10**

Introduction to automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, Flexible fixturing.

To le

UNIT II **9**

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods

UNIT III **8**

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Computer aided process planning, Case studies & industrial applications.

UNIT IV **9**

Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control-Flexible Manufacturing System- Shop floor control systems- Concurrent Engineering

UNIT V **9**

Low cost automation-Mechanical & Electro mechanical Systems, Assembly Automated Material handling- Robotics- Pneumatics and Hydraulics- Illustrative Examples and case studies.

TEXT BOOKS:

1. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.
2. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing,prentice Hall
3. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition,Pearson
4. YoramKoren, Computer control of manufacturing system, 1st edition

Course Coordinator **HOD**

Mr.Lenin Rakesh **Dr. K. Balasubramanian**

U18PCME7L1	**DESIGN AND ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	1
	Prerequisite – CAD /CAM Laboratory				
	Course coordinator Name & Department – Dr.C.M.Meenakshi Department of Mechanical Engineering				

OBJECTIVES

This course will enable the student To gain knowledge about the basic fundamentals of Analysis in Design of Simple Machine Elements.

COURSE OUTCOMES (COs)

CO1	Students willunderstand the benefits of Computer Aided Design
CO2	Students will recognize different analyzing software tools.
CO3	Students will be able use the computer aided manufacturing for creating various machine elements.
CO4	Students will be able to apply the concepts of 2D Design and Modeling
CO5	Students Will be able to design 3D models
CO6	Students Will able to justify the machine elements after analysis

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	g	h	i	j	k	l
2	CO1	3	3	3					2			3	
	CO2	3	3	3					2			3	
	CO3			3	3	3			1			3	
	CO4					2			1			3	
	CO5					2			1			2	
	CO6						2	2	2			2	
	Category	Professional Core											
4	Approval	47th Academic Council, July 2018											

LIST OF EXPERIMENTS:

A. PROGRAMMING IN MATLAB

1. Simple Applications in Arithmetic, Linear Algebra, Matrix operations.
2. Basic 2-D plots like i) Creating the circle ii) Creating the sine curve

B. MESHING AND ANALYSIS

1. Simple Meshes using a Meshing Software
2. Stress analysis of a plate with circular hole
3. Stress analysis of beams (Cantilever, Simply supported and fixed beams)
4. Thermal analysis of hot fluids in a pipe line
5. Mass flow of flue gases in an exhaust pipe
6. Harmonic analysis of a thin plate under axial loading
7. Mode frequency of a 2D component

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.

The students in convenient groups of not more than 4 members have to take one small item for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution.

The item chosen may be small machine elements (Example- screw jack, coupling, machine vice, cam and follower, governor etc) attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic/pneumatic devices etc.

The students are required to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts related to fabrication.

Course Coordinator **HOD**

Dr. K. Balasubramanian

Dr.C.M.Meenakshi

U18EEME7P1	**PROJECT -I**	**L**	**T**	**P**	**C**
	Total Contact Hours –16 periods per week	0	0	8	4
	Prerequisite – Professional Courses				
	Course coordinator Name & Department – Dr.K.Balasubramanian Department of Mechanical Engineering				

OBJECTIVES

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new creative problem which may be the design and manufacture of a system, a research investigation, project management or a design problem.

COURSE OUTCOMES (COs)

CO1	Tabulate a comprehensive report covering core related information, literature survey and describe the problem statement, project work details and conclusion.
CO2	Summarize the final report in typewritten form as outlined in the guidelines.
CO3	Make use of the prescribed regulations to built the continuous assessment report
CO4	Motivate the studentto design and analyse the mechanical components
CO5	Understand the different fabrication processes.
CO6	Formulate assertiveness to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3							2			1	
	CO2	3						3	2	3		1	
	CO3			3	3	3		3				1	
	CO4					2		3		2		1	
	CO5					2							
	CO6						2	3	2				
3	Category	Employment Enhancement											
4	Approval	47th Academic Council, July 2018											

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to undergo learning in research oriented areas, collecting survey and documents on the growing fields in technology

The students as an individual will choose one topic which will be the topic of his project work in the final semester. Every project work shall have a guide who will be the faculty of the institution.

Course Coordinator **HOD**

Dr. K. Balasubramanian **Dr. K. Balasubramanian**

18MCAB713	**BEHAVIORAL AND INTERPERSONAL SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	0
	Prerequisite – Nil				
	Course coordinator Name & Department –Department of Mechanical Engineering				

Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing differentaspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.

To help the students to understand the importance of non-verbal aspects of effective communication.

To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.

To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

- Motivational lectures
- Group Discussions/activities
- Case Study
- Games/Stimulation Exercises
- Role-Playing
- Mindfulness training.

Course Coordinator **HOD**

Dr. K. Balasubramanian

18MCAB714	**NATURE CLUB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Nature club (bird watching, recognizing plants at institute/at home, recognizinglocal animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18EEME8P2	**PROJECT WORK-II**	**L**	**T**	**P**	**C**
	Total Contact Hours –16 periods per week	0	0	16	8
	Prerequisite – Professional Courses				
	Course coordinator Name & Department – Dr.K.Balasubramanian Department of Mechanical Engineering				

OBJECTIVES

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

COURSE OUTCOMES (COs)

CO1	Identify core related information, literatures and describe the problem statement, project methodology and conclusion.
CO2	Summarize the final report in typewritten form as outlined in the guidelines.
CO3	Apply the prescribed regulations to built the continuous assessment report
CO4	Motivate the students to design innovatively and evaluate the functioning of mechanical components
CO5	Assess different fabrication processes.
CO6	Formulate assertiveness to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3							2			1	
	CO2	3						3	2	3		1	
	CO3			3	3	3		3				1	
	CO4					2		3		2		1	
	CO5					2							
	CO6						2	3	2				
3	Category	Employment Enhancement											
4	Approval	47th Academic Council, July 2018											

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to undergo learning in research oriented areas, collecting survey and documents on the growing fields in technology

The students as an individual will choose one topic which will be the topic of his project work in the final semester. Every project work shall have a guide who will be the faculty of the institution.

The topic chosen may be related to small machine elements (Example- screw jack, coupling, machine vice, cam and follower, governor etc) attachment to machine tools, tooling (jigs,

fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic/pneumatic devices etc.

The student is required to collect literature survey regarding the selected topic to be extended in the next semester. He has to demonstrate its working apart from submitting the project report. The report should contain study material, literature and whatever further deemed important related to his work.

Course Coordinator **HOD**

Dr. K. Balasubramanian **Dr. K. Balasubramanian**

18MCAB815	**INNOVATION - PROJECT BASED – SC., TECH, SOCIAL, DESIGN & INNOVATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non - conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

- Exposure to social problems (which are amenable to technological solutions)
- Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance.

Course Coordinator **HOD**

Dr. K. Balasubramanian

PROFESSIONAL ELECTIVE COURSES

U18PEME011	**ADVANCED INTERNAL COMBUSTION ENGINES**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Applied Thermodynamics.				
	Course Coordinator Name & Department – Mr.J.Manikandan Department of Mechanical Engineering				

OBJECTIVES

- To familiarize with the terminology associated with IC engines.
- To understand the basics of IC engines.
- To understand combustion, and various parameters and variables affecting it in various types of IC engines.
- To learn about various systems used in IC engines and the type of IC engine required for various applications

COURSE OUTCOMES (COs)

CO1	To explainengine exhaust emission control and basics of fuel injection systems
CO2	To summarize the concept of alternate fuels.
CO3	Illustrate the recent developments in Diesel Fuel Injection Systems.
CO4	Discuss the formation of various pollutants and methods of controlling emissions
CO5	Evaluate the performance of Air assisted Combustion
CO6	Understand the basics of Hybrid Electric Vehicles

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1								2			1	
	CO2			3				2	3	3		1	
	CO3			3	3	2		2			1	1	
	CO4					2		2		2		1	
	CO5					2							
	CO6						2	3	2				
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I : **[9]**

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection – Stages of combustion – Normal and Abnormal combustion – Knock – Factors affecting knock – Combustion chambers.

UNIT II : **[9]**

Diesel Fuel Injection Systems – Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion – Introduction to Turbocharging.

UNIT III : [9]

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV : [9]

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel – Properties, Suitability, Merits and Demerits – Engine Modifications.

UNIT V : [9]

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles – NOxAdsorbers – Onboard Diagnostics.

TEXT BOOKS:

1. Ramalingam. K.K., “Internal Combustion Engine Fundamentals”, Scitech Publications, 2002.
2. Ganesan, “Internal Combustion Engines”, II Edition, TMH, 2002.
3. Mathur. R.B. and R.P. Sharma, “Internal Combustion Engines”., DhanpatRai& Sons 2007.

REFERENCES

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PEME12	**DESIGN FOR MANUFACTURING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – MACHINE DESIGN, MANUFACTURING TECHNOLOGY				
	Course Coordinator Name & Department – Mr. Jeevabharathi/ Department of Mechanical Engineering				

OBJECTIVES

- At the end of this course the student should be able to understand the design principles of casting, welding, forming, machining and assembly, by considering various manufacturing constraints.

COURSE OUTCOMES (COs)

CO1	Students will learn the principles of manufacturing
CO2	Students will Understand the Design for manufacturing
CO3	Students will able to relate welding and its applications
CO4	Students will able to select fasteners for their design
CO5	Students will able to summarize about design principles of casting and machining
CO6	Students will able to adopt the principles of machining and assembly in design

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	E	f	g	h	i	j	k	l
2	CO1												1
	CO2	3	3							2			
	CO3		3				2				2		
	CO4	3											
	CO5		3				2						
	CO6												
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

General design principle for manufacturing - Process capability- Surface finish – tolerances – features of tolerance – cumulative effect of tolerance – Geometric tolerances.

UNIT II **9**

Fits- Selective assembly- Deciding the number of groups, control of axial play- Grouped datum systems- Types- Automated assemblies- laminated shims assemblies.

UNIT III **9**

True position theory- Virtual size concept- True position tolerancing- fixed fasteners- Floating fasteners- zero true position tolerances- Functional gauging- paper layout gauging.

UNIT IV **9**

Form design of castings- Redesigning- Parting line consideration- Minimizing core requirements- economic design of castings- Form design of weldments- Welding symbols- redesigning cast members using weldments- Economic weldments.

UNIT V **9**

Design for assembly- Design for inspection- Design for machining- Redimensioning based on manufacturing datums- Design of reduce value addition – Parts cut to length – Machined round holes- Blind & Through holes – Design consideration for various machining operations.

TEXTBOOK:

1. Spotts M.F – "Dimensioning & Tolerancing for Quantity Production" – Prentice Hall

REFERENCES:

1. Harry Peck – "Designing for Manufacture" – Pitman Publications, 1973.
2. James G.Bnalla- "Hand book of Product Design for Manufacturing".
3. www.bookchums.com › Books › Free ebooks

Course Coordinator **HOD**

Dr. K. Balasubramanian

Mr. Jeevabharathi

U18PEME13	**SPECIAL CASTING PROCESS**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Manufacturing Processes ,Manufacturing Technology				
	Course Coordinator Name & Department – Dr.Golden Renjith Nimal, Department of Mechanical Engineering				

OBJECTIVES

Understand the concepts of molding and casting

COURSE OUTCOMES (COs)

CO1	Recall and perform the basic concepts of casting processes.
CO2	Make use of modern casting industry tools (real and virtual).
CO3	Student will able to analyze a casting design in terms of casting parameters and cost estimates using technical methodology.
CO4	Improve the knowledge on designing parameters of casting.
CO5	Discuss the different fabrication processes.
CO6	Determine the advancements in casting processes to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	B	c	d	e	f	g	h	i	j	K	l
2	CO1								2			1	
	CO2			3				2	3	3		1	
	CO3			3	3	2		2			1	1	
	CO4					2		2		2		1	
	CO5					2							
	CO6						2	3	2				
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **10**

Introduction to Casting: Scope of Foundry, Features of casting, Solidification, Risering, Gating, Patterns, Moulding and core making, Defects, Sand casting -Need for special casting process-Applications.

UNIT II **7**

Shell Moulding: Process-Machines-Pattern-Sand, resin and other materials – Process parameters – Characteristics of shell mould casting-'D' Process – Applications

UNIT III **8**

Investment casting: Process- Pattern and mold materials – Black mold and ceramic shell mold - Mere Cast and Shaw process – Applications.

UNIT IV **8**

Centrifugal casting: Types – True centrifugal casting – semi centrifugal casting - Centrifuging– Equipment - Applications.

Die casting: Equipment – Types – Hot chamber – Cold Chamber – Applications.

UNIT V **12**

Reciprocating continuousmould process – Direct chill process – Use of steel, Aluminum, brass material in continuous casting. CO_2Mould / Core hardening process – Full Mould process: Principle – Applications, Special processes like Squeeze casting and Electroslag casting processes.

TEXT BOOKS:

1. Flinn and Richard Aloysius, *Fundamentals of Metal Casting*, Addison Wesley Pub. Co.
2. Groover M.P, *Introduction to manufacturing processes*, John Wiley & Sons, 2012
3. Prashant P Date, *Introduction to manufacturing technologies Principles and technologies*, Jaico publications, 2010 (new book)
4. Rao P.N, *Manufacturing Technology: Foundry, Forming And Welding*, Tata McGraw Hill, 2008.

REFERENCES :

1. Hajra Chowdary S.K. The Fundamentals of Work Shop Technology. Vol. I & II, Media Publishers, 1997.
2. Higgins R.A, Engineering Metallurgy – Vol. II, 1998.
3. Jain P.L, Foundry Technology, 1992.
4. Sharma OP.C A Text Book of Production Technology, S.Chand& Company Ltd, New Delhi, 2007

Course Coordinator **HOD**

Dr.Golden Renjith Nimal

Dr. K. Balasubramanian

	INDUSTRIAL ENGINEERING	L	T	P	C
U18PEME014	Total Contact Hours –45	3	0	0	3
	Prerequisite – Manufacturing Processes ,Manufacturing Technology				
	Course Coordinator Name & Department – Mrs. G. Sucharitha/ Department of Mechanical Engineering				

OBJECTIVES: To impart knowledge in undertaking market research, demand forecasting and costing for designing plant, operation, production, maintaining standards of professional ethics.

COURSE OUTCOMES (COs)

CO1	After completing the course students will be able to understand the industrial engineering concept and apply in the industrial engineering Environment.
CO2	Describe different aspects of production planning and control in manufacturing industries.
CO3	Demonstrate the knowledge of designing plants and controlling Production
CO4	Students will able to analyzeand implement different concepts involved in methods study and understanding of work content in different situations.
CO5	Students will be able to build leadership qualities and develop communication skills.
CO6	Students will be able to create control charts for different attributes and understand the acceptable quality levels in the in the production.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			3	3								
	CO2				3					3			1
	CO3	1						3					
	CO4		1					3		2			
	CO5												
	CO6									2			
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Definitions-Productivity, Effectiveness, and Types-Factors Influencing Productivity-Techniques To Improve Productivity, Technology Based Techniques and material Based Productivity Improvement-Inventory Control-M.R.P-Quality Circles-Brainstorming-Pareto Analysis-Cause And Effect Analysis-TQM-Zero Defects-Flextime-Just In Time-Ergonomics-Reliability Improvement-Modular Design-Maintainability**.**

UNIT II **9**

Types of Layout, Its Advantages and Disadvantages-Preference of Different Types of Layout, Plant Location and Decision-Definitions: Group Technology-Principles of Material Handling. Loading- Master Scheduling- Perpetual Loading-Order Scheduling-Loading By Scheduled Method-Index Method Of Scheduling-Factors Influencing Scheduling-Production Planning And Control-Routing And Dispatching-Job Card-Job Order-Order Control And Machine Load Chart.

UNIT III **9**

Techniques of Work Study-Procedure-Method Study, Types of Process Charts and Diagrams-Multiple Activity Chart-Utility-Time Study-Micro Motion Time Study-PMTS-Work Sampling-Job Analysis-Job Evaluation and Merit Rating-Wage and Wage Incentive.

UNIT IV **9**

Introduction-Nature And Scope-Objectives-Hawthorne Studies And Its Conclusion-Individual Behaviour-Group Behaviour,Types Of Groups-Formal And Informal Organizations-Fatigue – Accident,MajorFactors,Prevention-Importance And Methods Of Training To The Employees, Methods And Aids-Leadership And Leadership Styles-Communication And Its Importance.

UNIT V **9**

Introduction to Quality Control-Statistical Measures-Control Chart-Types –Control Chart for Attributes-Control Chart for Number of Defects per Unit-Acceptance Sampling-Basic Probability-Normal Distribution-Acceptable Quality Level-Lot Tolerance Percent Defective-Average Outgoing Quality

TEXT BOOKS:

1. Khanna.O.P. Industrial Engineering and Management, Khanna Publishers, New Delhi, 2000.
2. Kumar B, Industrial Engineering, Hanna Publishers,2004
3. Ramachandran S and K.Pandian Principles Of Management And Industrial Psychology, Air Walk Publishers, 2007.

REFERENCES:

1. Gupta And Petal, Work Study- Khanna Publishers, 1998.
2. onlinevideolecture.com/**ebooks**/?subject=**Industrial**%20**Engineering**...

Course Coordinator **HOD**

Mrs.G.Sucharitha **Dr. K. Balasubramanian**

U18PEME21	**POWER PLANT ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Applied Thermodynamics				
	Course Coordinator Name & Department – Dr.S.Thirumavalavan / Department of Mechanical Engineering				

OBJECTIVES

To understand the various components, operations and applications of differenttypes of power plants

To provide an overview of power plants and the associated energy conversion issues

COURSE OUTCOMES (COs)

CO1	Remembers the types of turbines, boilers and condensers.
CO2	Understands the types of boilers and working of generators
CO3	Analyze the different types of reactors and learn the key knowledge.
CO4	Students understands the facts and ideas of hydro power plants
CO5	Students are able to learn and evaluate the tariffs.
CO6	Student understands the installation of nuclear power plants and their adv and disadvantages

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	g	h	i	j	K	l
2	CO1	3											2
	CO2			3		1				3		1	
	CO3	3					2						
	CO4			3		1		2					
	CO5									3			
	CO6	3				1							
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

OBJECTIVES:

To provide an overview of power plants and the associated energy conversion issues

CONTENTS:

UNIT-I (9)

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT-II (9)

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III (9)

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT-IV **(9)**

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT-V **(9)**

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

TEXT BOOKS:

1. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
2. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
3. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

REFERENCES:

1. Nagpal G.R- Power plant Engineering-Khanna publishers, Delhi, 1998
2. Rai G.D-Power plant engineering,khanna publishers, 2000

Course Coordinator **HOD**

Dr.S.Thirumavalavan

Dr. K. Balasubramanian

U18PEME22	**TRIBOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Materials science, Machine design.				
	Course Coordinator Name & Department – Mr. Jose Ananth Vino/Department of Mechanical Engineering				

OBJECTIVES: To understand the theories of friction and wear and to design best bearings .

COURSE OUTCOMES (COs)

CO1	The students will be able to apply theories of friction to various practical situations by analyzing the physics of the process.
CO2	The students will be able to understand the various types of wears and wear mechanism.
CO3	They will understand the various surface measurement techniques and effect of surface texture on Tribological behavior of a surface.
CO4	They will be able to select materials and lubricants to suggest a tribological solution and will be able to design journal bearings
CO5	The students will be able to design a rolling contact bearing.
CO6	The students will be able to understand the recent developments in the field and can offer tribological solutions

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	g	h	i	j	k	L
2	CO1	3											2
	CO2			3		1				3		1	
	CO3	3					2						
	CO4			3		1		2					
	CO5									3			
	CO6	3				1							
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

Unit 1: Friction, theories of friction, Friction control, Surface texture and measurement, genesisof friction, instabilities and stick-slip motion.

Unit 2: Wear, types of wear, theories of wear, wear prevention.

Unit 3: Tribological properties of bearing materials and lubricants.
Lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely longplane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), FiniteBearings, Design of hydrodynamic journal bearings

Unit 4: Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternatingloads, piston pin lubrications, application to journal bearings and design of Journal bearings.

Unit 5: Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation,Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings, design of rolling contact bearings.

References:

Cameron, "Basic Lubrication Theory", Ellis Horwood Ltd, 1981.
Principles in Tribology, Edited by J. Halling, 1975
Fundamentals of Fluid Film Lubrication – B. J. Hamrock, McGraw Hill International,1994
Design data book compilled by PSG college of technology.

Course Coordinator
Mr.Jose Ananth Vino

HOD

Dr. K. Balasubramanian

U18PEME23	**COMPOSITE MATERIALS AND TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Materials Engineering				
	Course Coordinator Name & Department – Dr. C.M.Meenakshi ,Department of Mechanical Engineering				

OBJECTIVES

To understand the mechanical behaviour of composite materials

To get an overview of the methods of manufacturing composite materials

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students will able to discover the mechanical behaviour and application of composite materials
CO2	students will beable to understand the fundamentals of composite material strength and its mechanical behavior
CO3	Students will be able to analyze fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
CO4	Students will be able to demonstrate the thermo-mechanical behavior and study of residual stresses in Laminates during processing applying Laminate Theories (CLT)
CO5	Students will be able appraise the residual stresses in an isotropic layered structure such as electronic chips.
CO6	Students will be able design composite material with respect to application's mechanicalstrength requirement.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	G	h	I	J	K	L
2	CO1	3			1				2			1	
	CO2	3						3	2			1	1
	CO3			3	2	3		1				1	
	CO4					2		3				1	
	CO5				2	2							
	CO6		1	3				3	2				
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **12**

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction

of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

UNIT II **8**

Manufacturing of composite materials-Fiber Reinforced Composites- Fundamentals- bag moulding, compression moulding, pultrusion, filament winding, other manufacturing processes- Metal Matrix composites- Powder Metallurgy- Diffusion Bonding-Melt Stirring-Rheocasting- squeeze casting, , other manufacturing processes

UNIT III **9**

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT IV **8**

Performance of laminates – Static Mechanical Properties- Test Method and Analysis, Unidirectional Laminate, Cross Ply Laminates and Multidirectional Laminates- Compressive Properties-Flexural Properties-Inter laminar shear strength—Fatigue properties-Impact Properties- Environmental Effect

UNIT V **8**

Failure predictions-design considerations-joint design-codes-design examples.Optimization of laminated composites-Application of FEM for design and analysis of laminated composites-static bending analysis, buckling analysis, free vibrations, natural frequencies.

TEXTBOOKS:

1. Daniel gay, Composite Materials, CRC Press, 3rd edition.
2. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
3. Krishnan Chawla ,Composite Materials Science and Engineering, Springer publications,2012.
4. Mallick P.K , Fiber Reinforced Composites –Materials ,Manufacturing and Design-CRC Press- 3rd edition

REFERENCES:

1. Michael Hyer, Stress Analysis of Fiber- reinforced composite Materials, Tata McGraw Hill, 1998.
2. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, 1994.
3. http://www.springer.com/in/book/9780387743646
4 https://books.google.co.in/books/about/Composite_Materials.html?id=5Q6oUTFO0RgC

Course Coordinator **HOD**

Dr.C.M.Meenakshi **Dr. K. Balasubramanian**

U18PEME24	**INDUSTRIAL ROBOTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –BacisElectrical and Electronics Engineering				
	Course Coordinator Name & Department –R.Hariharan ,Department of Mechanical Engineering				

OBJECTIVE:

- To understand the basic concepts associated with the design and Functioning andapplications of Robots To study about the drives and sensors used in Robots
- To learn about analyzing robot kinematics and robot programming

COURSE OUTCOMES (COs)

CO1	recognize the basic engineering
CO2	demonstrate the design of robotics
CO3	experiment with robot kinematics and robot programming
CO4	To survey recent application of Robots
CO5	Explain about force and torque sensing
CO6	Topredict learrn about material handling

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	g	h	i	j	k	l
2	CO1	2											
	CO2					3			2				2
	CO3	2											
	CO4					3					1		
	CO5	2		3		3							
	CO6	2											
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Definition of Robot – Laws of Robotics – Basic concepts – Robot Configuration – Types of Robot drives – Basic Robot motions – Point to Point control – Continuous path control – Accuracy and repeatability.

UNIT II **9**

Control system components-Control system analysis–Actuation and feed back– manipulators – Direct kinematic model and inverse kinematic model – Coordinate transformation – Robot dynamic modeling – Types of Robot and end effectors - Tools as end effectors

UNIT III **9**

Range sensing – Proximity sensing – touch sensing – force and torque sensing.Introduction to machine vision – Sensing and digitalizing – Image processing and analysis.

UNIT IV **9**

Methods online/ offline – Show and teach – Teach pendant – lead and teach – Languages Explicit – task level – capabilities and limitation – Artificial intelligence – Knowledge representation – Search techniques.

UNIT V **9**

Applications of robots in machining – Welding – Assembly – Material handling – processing – Loading and un loading – CIM inspection – Hostile and remote environments – Non industrial applications.

TEXTBOOK:

1. Michael P.Groover, Mitchell Weiss, Industrial Robotics Technology Programming and applications, - McGraw Hill International Editions, 1989.

References:

1. Fu K.S, R.C. Gonalez , C.S.G. Lee, Robotics, Control sensing, Vision and Intelligence, - McGraw Hill International Editions, 1987.
2. Michael – B.Histland, David. G. Aliatoce., Introduction to Mechatronics and Measurement Systems, McGraw Hill International. Edition, 1999.
3. www.e-booksdirectory.com › Engineering

Course Coordinator **HOD**
R.Hariharan **Dr. K. Balasubramanian**

U18PEME31	**GAS DYNAMICS AND JET PROPULSION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45				
	Prerequisite – HEAT TRANSFER	**3**	**0**	**0**	**3**
	Course Coordinator Name & Department – Mr. V. Srinivasan,Department of Mechanical Engineering				

OBJECTIVE:

- To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.
- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
- To understand the features of compressible isentropic flows and irreversibilities like shocks.
- To provide a basic knowledge of jet and rocket propulsion technologies.

Course Outcomes

CO1	Will be able to recognize compressible flow through ducts, jet propulsion and space propulsion.
CO2	Will understand the basic difference between incompressible and compressible flow.
CO3	Will be able to predict the phenomenon of shock waves and its effect on flow.
CO4	Will derive the jet propulsion concepts
CO5	To solve the rocket propulsion problems
CO6	To compare the types of rocket engine

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	J	K	l
2	CO1	3											
	CO2		2										
	CO3			3	2		3			3			
	CO4					1			2				
	CO5							1			1	1	
	CO6												
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

Objectives:

- To understand the features of compressible isentropic flows and irreversibilities like shocks.
- To provide a basic knowledge of jet and rocket propulsion technologies.

Contents:

UNIT I **9**

Compressible fluid flow-energy and momentum equations, stagnation stages, various regions of flow, reference velocities, effect of Mach number on compressibility. Types of waves, Mach cone, Mach angle.

UNIT II **9**

Flow through variable area ducts-nozzles and diffusers, Mach number variation, stagnation and critical states, area ratio as a function of Mach number.Flow through constant area ducts-

with friction (Fanno flow), with heat transfer (Reyleigh flow), Variation of flow properties. Use of Gas Tables and Charts.

UNIT III **9**

Governing equations, variation of flow parameters across the normal and oblique shocks.PrandtlMeyer relations. Flow in variable area ducts with normal shocks. Use of Tables and Charts.

UNIT IV **9**

Types of jet engines-turboprop, turbojet, ramjet, pulsejet. Aircraft propulsion theory, performance analysis of jet engines, parameters affecting flight performance, thrust augmentation.

UNIT V **9**

Types of rocket engines, propellants, combustion instabilities, rocket propulsion theory, performance of rocket engine, multistage rockets, orbital and escape velocities.

TEXTBOOKS:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. Ganesan V, Gas Turbines, Tata McGraw-Hill Publishing Company Ltd., 2003.
3. H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
4. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.
6. Yahya S.M. Fundamentals of Compressible Flow, New Age International (P) Ltd., New Delhi, 2003.
7. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.

REFERENCES:

1. Cohen H. Rogers GFC, Saravanamuttoo HIH, Gas Turbines Theory, Addison-Wesley Long man Ltd., 2001.
2. Khajuria P.R and Dubey S.P., Gas turbines and Propulsive Systems, DhanpatRaiPublications (P) Ltd, New Delhi 2003.
3. Philip G Hill and Carl R. Peterton, Mechanics and Thermodynamics of Propulsion, Addison-Wesley Publishing Company, 1999.
4. freecomputerbooks.com/**Total-Quality-Management**-and-Six-Sigma.htm.

Course Coordinator **HOD**

Mr. V. Srinivasan Dr. K. Balasubramanian

U18PEME32	**DESIGN OF JIGS FIXTURES AND PRESS TOOLS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – MANUFACTURING TECHNOLOGY				
	Course Coordinator Name & Department – R.Hariharan, Department of Mechanical Engineers				

OBJECTIVES

To understand the functions and design principles of Jigs, fixtures and press tools To gain proficiency in the development of required views of the final design.

COURSE OUTCOMES (COs)

CO1	To discover the knowledge on standard components
CO2	Will summarize and the principle and use of standards
CO3	Determine the use and design of fixtures
CO4	Classify the design of press tools
CO5	Develop the new components using CNC programming
CO6	Invent the concept of technical design

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3											
	CO2	3		3	2					3			
	CO3			3			2						
	CO4	3		3					2			1	
	CO5	3											
	CO6	3		3									
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **12**

Introduction to jigs & Fixtures - Design principles of jigs & fixtures - Locating principles and elements – Standard parts – Clamping devices, Mechanical ,Pneumatic and hydraulic actuation, Clamping force analysis.

UNIT II **12**

Drill bushes - Different types of jigs- plate, latch, channel, box, post, angle plate, angular post, turnover, pot jigs - Automatic drill jigs – Rack & pinion operated and Air operated jig components - Design and development of jigs for the given components.

UNIT III **12**

Types of fixtures - Boring, Lathe, Milling, Broaching fixtures – Grinding, Planning and Shaping fixtures – Assembly, Inspection and Welding fixtures – Modular fixtures – Design and development of fixtures for the given components.

UNIT IV **12**

Press working terminology - Types of Presses and Press Accessories – Computation of capacities and tonnage requirements – Strip layout

UNIT V **12**

Design and development of various types of Cutting, Forming and Drawing dies – Blank development for cylindrical and non cylindrical shells – Compound , Progressive and Combination dies.

TEXTBOOK:

1.Design of Jigs, Fixtures and Press tools, C.Elanchezhian,T.Sunderselvan, Vijayaramnath B, Eswar Press, 2005.

REFERENCES :

1. Akgoroshkin, Jigs and Fixture Handbook, Mix Publishers, Moscow, 1983 .
2. ASTME Handbook of Fixture design,1960.
3. Design Data, PSG Tech, Coimbatore, 2003.
4. Fundamentals of tool Design ASTME, 1984.
5. https://www.overdrive.com/media/.../design-of-**jigs-fixtures-and-press-to**...

Course Coordinator **HOD**
R.Hariharan **Dr. K. Balasubramanian**

U18PEME33	**UNCONVENTIONAL MACHINING PROCESS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Manufacturing Processes				
	Course Coordinator Name & Department – Dr. R. J. Golden Renjith Nimal ,Department of Mechanical Engineering				
OBJECTIVES • To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications					
COURSE OUTCOMES (COs)					

CO1	Upon completion of this course, the students can able to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications.
CO2	To understand the need and importance of non traditional machining methods.
CO3	To learn the basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining.
CO4	To study the fundamentals of tool design, surface finishing and metal removal rate of electro chemical grinding , electro chemical machining and electro chemical honing.
CO5	To understand principles of operation, types of electrodes and process parameters and machine tool selection in EDM and Electric discharge grinding and wire cut process.
CO6	To learn the basics of Electron Beam Machining and comparison of thermal and non thermal processes.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	J	K	l
2	CO1	3	1	3			1	1	1	1			
	CO2	1	2	3			1	1	2	3	3	1	
	CO3	1	1	2								3	
	CO4	2	2	3			1	1	1	3		1	
	CO5	1	2	3								2	
	CO6	1	2	3			1	1	2	1	3		
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNITI **7**

Introduction: Need for non-traditional machining methods-Classification of modern machining processes — considerations in process selection. Materials, Conventional vs Unconventional Machining Processes, Applications parameters, Economic considerations, applications and limitations, recent development

UNIT II **9**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT III **9**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT IV **10**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications.

UNIT V **10**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron BeamMachining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOOKS:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York,1987.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

Course Coordinator **HOD**

Dr. R. J. Golden Renjith Nimal **Dr. K. Balasubramanian**

U18PEME034	**PROCESS PLANNING AND COST ESTIMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	1	0	3
	Prerequisite – MANUFACTURING PROCESSES				
	Course Coordinator Name & Department – Mr.N.Lenin Rakesh ,Department of Mechanical Engineering				

OBJECTIVES

To introduce process planning concepts to make cost estimation for various products

COURSE OUTCOMES (COs)

CO1	Upon completion of this course, the students will be able to make use of the concepts of process planning and cost estimation for various products
CO2	Students will be able to do material evaluation and selection for various products.
CO3	Students will be able to analyze the jigs, fixtures and quality assurance methods
CO4	Describe the estimating procedure and evaluate different costs in the industry
CO5	Students will be able to understand the machine time and calculate for different operations
CO6	Students will be able to estimate forging, welding and foundry costs.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	J	K	l
2	CO1	3						2				1	2
	CO2		3			2				1			
	CO3		2			3	2			3			
	CO4			1		3					2		
	CO5		2				2			3			2
	CO6	1						3				3	

3	Category	Professional Elective
4	Approval	47th Academic Council, July 2018

UNIT I **9**

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

UNIT II **10**

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

UNIT III **10**

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost

UNIT IV **8**

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding

UNIT V **8**

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

TEXTBOOKS:

1. Adithian M and B.S. Pabla, Estimation and Costing, Konark publishers Pvt. Ltd., 1989.
2. ChitaleA.K and R.C.Gupta, Product Design and Manufacturing, Prentice Hall Pvt. Ltd.., 2005
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.
4. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
5. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.

REFERENCES :

1. BangaT.R and S.C.Sharma, Estimations and Costing, Khanna Publishers,1988.
2. https://books.google.com/books?id=A9-ZXblNrPoC
3. Joseph G Monks, Operation Management, Theory & Problems, McGraw Hill Book Company, 1987.
4. Namua Singh, System Approach to computer integrated Design and Manufacturing, John Wiley &Sons,Inc.,1996.
5. Narang G.B.S and V.Kumar, Production and Costing, Khanna Publishers, 1995.

Course Coordinator **HOD**

Mr.N.Lenin Rakesh **Dr. K. Balasubramanian**

	AUTOMOBILE ENGINEERING	L	T	P	C
U18PEME41	Total Contact Hours –45	3	0	0	3
	Prerequisite – Applied Thermodynamics				
	Course Coordinator Name & Department – Mr. S.Sabarish , Department of Mechanical				

OBJECTIVES

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

COURSE OUTCOMES (COs)

CO1	Will be able to recognize vehicle structures
CO2	Will be able to explain the different types of engines
CO3	Transmission systems will be identified
CO4	Will be able to distinguish the engine auxiliary systems
CO5	Students will learn to derive and measure forces on vehicle structure
CO6	Students elaborate about suspension systems and steering wheels

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	L
2	CO1	3	3	1					2	2		3	3
	CO2	3	3	1					2	2		3	
	CO3								2			3	
	CO4	3	2	1						2			
	CO5	2	3						2	2		2	1
	CO6	2	3	1					2	2		2	
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT-I **9**

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT).

UNIT-II **9**

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition, capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

UNIT-III **9**

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT-IV **9**

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

UNIT-V **9**

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.

TEXT BOOKS:

1. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
2. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.

REFERENCES

1 Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.
2. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.

Course Coordinator **HOD**

Mr. S.Sabarish Dr. K. Balasubramanian

U18PEME42	**MECHANICAL VIBRATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Theory of Machines				
	Course Coordinator Name & Department – Mr. Jose Ananth Vino ,Department of Mechanical Engineering				

OBJECTIVES

The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

COURSE OUTCOMES (COs)

CO1	Understand the sources of vibration and noise in various appliances.
CO2	Will be able to develop schematic modes for physical systems and formulate governing equations of motion.
CO3	Recognize damping stiffness and inertia in mechanical systems.
CO4	Students will be able to examine rotating and reciprocating systems and evaluate critical speeds
CO5	Analyze and design machine supporting structures, vibration isolators and absorbers
CO6	Student will be able to apply all that has been learnt to improve upon newer techniques of reducing vibrations in machines and structures.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3							2			1	
	CO2	3		3				2	3	3		1	
	CO3	3		3	3	2		2			1	1	
	CO4	3				2		2		2		1	
	CO5	3				2							
	CO6	3					2	3	2				

3	Category	Professional Elective
4	Approval	47th Academic Council, July 2018

UNIT I **9**

Vibration principle- Equilibrium & Energy methods- Free vibrations-Viscous & coulomb damping- Forced vibration EXCITATION- Transmissibility –Resonance -Characteristics.

UNIT II **9**

Two degrees of freedom –Matrix form – Undamped free vibration – Principal modes – Co-ordinate coupling – Principal co-ordinates – Torsional vibrations – Holzer method – Work &Energy approach.

UNIT III **9**

Transient vibration – Time dependency – Laplace transforms – Step inputs – Pulse inputs – Duhamel's integral – Phase plane method – Shock spectrum.

UNIT IV **9**

Multi degrees of freedom – Equations of motion – Solution –Orthogonality of normal modes – Continuous system – Free & forced vibrations – Vibration analysis by FEM.

UNIT V **9**

Vibration instruments – Vibration absorber –Elastically supported dampers – Seismic instruments –Vibrometers – Pickups – Accelerometers – Mounting instruments – Amplitude & phase distortions.

TEXTBOOKS

1. Grover G.K – Mechanical Vibrations – Namchand& Bros. 2001.
2. Singh V.P- Mechanical Vibrations –Dhanpat Rai & Co, 2005.

REFERENCES:

1. booksformech.blogspot.com/.../**mechanical-vibrations**-by-vpsingh-pdf.ht.
2. Francis S.Tse, Iran E. Morse, Rolland T. Hinkle- Mechanical vibrations - CBS Publishers, 1983.
3. Thomson W.T – Theory of vibrations,Uniwin Hyman Ltd/CBS Publishers,1998.
4. Timoshenko S.P – Vibration Problems in Engineering – CBS Publishers, 1985.

Course Coordinator **HOD**

Mr. Jose Ananth Vino

Dr. K. Balasubramanian

U18PEME43	**ADVANCED TURBO MACHINES**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – HEAT TRANSFER				
	Course Coordinator Name & Department – Mr.S. Nakkeeran, Department of Mechanical Engineering				

OBJECTIVES

To develop skilled manpower in the field of turbo machines with the knowledge of

transport processes through the turbo machine passage, analytical, numerical and experimental tools for design, operation, performance evaluation and innovative research in the area of turbo machines"													
COURSE OUTCOMES (COs)													
CO1	Understand the performance evaluation, operation and maintenance of rotodynamic machines.												
CO2	Will be able to recognize and reproduce conceptual design of different components of thermal and hydro turbo machines.												
CO3	Design turbo machineries												
CO4	Apply the principle of machineries												
CO5	Develop axial and radial flow turbines												
CO6	Learn the principles and categorize the application of turbines												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	K	l
2	CO1												2
	CO2	3	3							2			
	CO3		3				2				2	3	
	CO4	3											2
	CO5		3				2						
	CO6												
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

UNIT II **9**

Types, stage and design parameters, flow analysis in impeller blades, Volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

UNIT III **9**

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT IV **9**

Stage velocity triangles, enthalpy-Entropy diagrams, stage losses and efficiency, work down factor, simple stage, design problems and performance characteristics.

UNIT V **9**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

TEXTBOOKS:

1. Ganesan V – Gas Turbines - Tata McGraw Hill Publishing Company, New Delhi- 2003.
1. Yahya S.M – Turbines, Compressors and Fans – Tata McGraw Hill Publishing Company,

2005.

REFERENCES:

1. Earl Logan Jr, RamendraRoy.,Handbook of Turbo Machinery., CRC Press.
2. https://books.google.co.in/books/about/Advanced_topics_in_turbomachinery_techno.html?id=qs9QAAAAYAAJ&redir_esc=y

Course Coordinator — Mr.S. Nakkeeran

HOD — Dr. K. Balasubramanian

U18PEME44	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Coordinator Name & Department – Dr. V. Balambica/Department of Mechanical Engineering				

OBJECTIVES

1. Tointroduce the student about the basic terms related to quality.
2. To familiarize the student about the basic principles of TQM.
3. To acquaint the student about the basic statistical tools used in process control.
5. To introduce the student to use various tools used in implementing and checking total quality management.

To familiarize the student about the different quality system used in auditing the quality of a company/industry /organization

COURSE OUTCOMES (COs)

CO1	To introduce to the student about the basic terms related to quality and concepts of quality management
CO2	To illustrate the basic principles of total quality management
CO3	Demonstrate tool utilization for quality improvement.
CO4	Explain the various techniques used to measure quality
CO5	Students will be able to validate a set of ideas on quality improvement.
CO6	Apply various quality systems and auditing on implementation of TQM.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			2		3		2	3	2	1	1	

	CO2			2		3		2	3	2	1	1	
	CO3			2		3		2	3	2	1	1	
	CO4			3		3		2	3	2	1	1	
	CO5			3		3		2	3	2	1	1	
	CO6			3		3		2	3	2	1	1	
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – AnalysisTechniques for Quality Costs, Basic concepts of Total Quality Management, HistoricalReview, Principles of TQM, Leadership – Concepts, Role of Senior Management,Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers toTQM Implementation.

UNIT II 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, ServiceQuality, Customer Retention, Employee Involvement – Motivation, Empowerment,Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership –Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development,Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III **9**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendencyand Dispersion, Population and Sample, Normal Curve, Control Charts for variables andattributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV **9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality FunctionDeployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality LossFunction, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA –Stages of FMEA.

UNIT V **9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System –Elements, Implementation of Quality System, Documentation, Quality Auditing, TS16949, ISO 14000 – Concept, Requirements and Benefits

TEXT BOOKS:

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc.2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCE BOOKS:

1. Evans. J. R. & Lindsay. W,M “The Management and Control of Quality”, (5th Edition),South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S. “Total Quality Management”, Butterworth Hcinemann Ltd., Oxford,1989.
4. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”,New Age International 1996.
5. Zeiri. “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

6. freecomputerbooks.com/**Total-Quality-Management**-and-Six-Sigma.htm

Course Coordinator **HOD**

Dr. V. Balambica. **K. Balasubramanian**

U18PEME51	**REFRIGERATION AND AIR CONDITIONING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Applied Thermodynamics ,BME				
	Course Coordinator Name & Department – Mr.J.Manikandan,Department of Mechanical Engineering.				

OBJECTIVES

- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To understand basic refrigeration processes
- To understand the basics of psychrometry and practice of applied psychometrics
- To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components

COURSE OUTCOMES (COs)

CO1	Will recall the basic concepts associated with refrigeration systems and air conditioning
CO2	To understand basic refrigeration processes
CO3	Students are able to examinethe basics of psychrometry
CO4	To acquire the skills required to model, analyse air-conditioning
CO5	Student Evalate the Estimation of cooling load calculations
CO6	Students can able to create own ideason air conditioning equipments and applications

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			1		2	1				3		2
	CO2							2					
	CO3	2		2			1		2				
	CO4	3	3								2		
	CO5			2									2
	CO6		3										
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

Use of Psychrometric and Refrigerant tables in the Examination is permitted.

UNIT I **(9)**

Review of thermodynamics, Principle of Refrigeration, Refrigeration methods-Air refrigeration (Theory only)-Bell-Coleman refrigeration, steam jet refrigeration, and Vapour

compression refrigeration-Uses of P-H charts-Cascade refrigeration, Vapour absorption refrigeration, Comparison of performance and COP

UNIT II (**9)**

Refrigerants, properties - Selection of refrigerants. Equipments-compressors-reciprocating, rotary, Condensers-evaporators-Cooling towers – Fans – Ducts

UNIT III (**9)**

Review of fundamental properties of air, Psychrometric processes -By pass factor-Requirement of comfort air-conditioning, Comfort and comfort chart, Factors governing optimum effective temperature.

UNIT IV (**9)**

Types of heat sources-Heat transmission through buildings, solar heating, Internal heat sources (Sensible &latent), outside air and fresh air load, Estimation of total load.

UNIT V **(9)**

Air conditioning equipments-Air filters, humidifiers, dehumidifiers, air washer, Commercial &industrial air conditioning systems, central air conditioning system, Application of refrigeration-Ice plant, Food storage plants,milk chilling plants, cryogenic in medicine& biological use, application of Air conditioning system-Car Industry, Stores and Railway A/C

TEXT BOOKS:

1. Arora C.P-Refrigeration & Air conditioning, Tata Machine graw hill, 2008

REFERENCES:

1. Jordon and Prister, Refrigeration and Air-conditioning-Tata McGraw Hill.
2. Roy.J.Dossat-Principles of Refrigeration-low price edition, 2001

Course Coordinator **HOD**

Mr.J.Manikandan **Dr. K. Balasubramanian**

	COMPUTATIONAL FLUID DYNAMICS	**L**	**T**	**P**	**C**
U18PEME52	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Fluid Mechanics and Machinery				
	Course Coordinator Name & Department – Dr.Ravi,Department of Mechanical Engineering				

OBJECTIVE:

- To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.
- To introduce Governing Equations of viscous fluid flows.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers
- To enable the students to understand the various discretization methods, solutionprocedures and turbulence modeling.

COURSE OUTCOMES (COs)	
CO1	Analyze various numerical techniques to find solution of fluid dynamics and heat transfer problems.
CO2	To developgoverning equations of viscous fluid flows
CO3	To understand the various discretization methods, solution procedures and turbulence modeling.
CO4	To formulate the calculation of flow field
CO5	To evaluate the performance of turbulence and algebraic models
CO6	To examine the heat conduction of Finite Element Methods

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	D	e	f	g	h	i	j	k	l
2	CO1	2											
	CO2					3			2				
	CO3	2											3
	CO4					3					1		
	CO5	2		3		3							
	CO6	2											
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Conservation of chemical species-The energy equation-Momentum equation-time averaged equations for turbulent flow-Turbulence-Kinetic energy equation-The general differential equation-Nature of co-ordination-Independent variable-Choice of co-ordinates-one way and two way coordinates

UNIT II **9**

Nature of numerical methods-Methods of deriving of discretization equations-Taylor series formulation-Variational formulation-Methods of weighted residuals-Control volume formulation

UNIT III **9**

Steady One Dimensional Conduction- Two and three dimensional conduction-Steady one dimensional convection and diffusion-Discretization equations for two dimensional convection and diffusion

UNIT IV **9**

Representation of pressure-gradient and continuity equation-stagged grid-momentum equations-pressure and velocity correction-pressure correction equation.Introduction to Finite Element Method-solution of steady heat conduction by FEM-incompressible flow-simulation by FEM.

UNIT V **9**

One, two equation model-high and low Reynolds number models-Reynolds stress models-Prediction of fluid and heat transfer using standard codes.

TEXTBOOKS:

1. Malasangara S., An Introduction to Computational Fluid Dynamics.,2nd edition.,TMG.,2010.
2. YunusCengel.,JohnCimbala., Fluid Mechanics,TMG.,2014.

REFERENCES:

1. Ghoshdastidar P.S-Computer Simulation of Flow and Heat Transfer-Tata McGraw Hill Publishing Company Ltd 1998.
2. Muralidhar K &Sundarrajan T-Computational Fluid Flow and Heat Transfer-Narosa, 2003
3. Versteeg H.K&Malalasekara W-An Introduction to Computational Fluid Dynamics-Longman.
4. **book**boon.com/en/**computational-fluid-dynamics-ebook**

Course Coordinator **HOD**

Dr.Ravi

Dr. K. Balasubramanian

U18PEME53	**MECHANICS OF FRACTURE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Mechanics of solids				
	Course Coordinator Name & Department – Mr.Jose Ananth Vino ,Department of Mechanical Engineering				

OBJECTIVES

The purpose is to give an introduction about fundamental theory in facture mechanics. Knowledge of failure mechanisms and the fracture mechanics is important in many fields of research and industrial applications..

COURSE OUTCOMES (COs)

CO1	The student will understand the different types of fractures and associated causes. .
CO2	The student will develop skills in deriving stress field and energy release rate around the crack tip and crack propagation under cyclic loading.
CO3	Understanding of fracture mechanics and its application.
CO4	Learn about fatigue crack growth and crack failures
CO5	Will learn about fracture failure modes
CO6	Learn fracture repair and analysis

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	3											

	CO2			3									
	CO3							2				1	
	CO4	3		3	3	2	2						
	CO5												
	CO6	3											
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Introduction- ductile fracture – brittle fracture. Crack in a structure-Griffith criterion cleavage fracture, , fatigue cracking- Service failure analysis. Elastic crack-Elastic crack tip stress field-Solution to crack problems, Effect of finite size stress intensity factor-Special cases- Irwin plastic zone correction – Actual shape of plastic zone- plane stress- plane strain

UNIT II **9**

Energy release rate- criterion for crack growth- Crack resistance curve-Principles of crack arrest- Crack arrest in practice.

UNIT III **9**

Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor-variable amplitude service loading, retardation model.

UNIT IV **9**

Elastic plastic fracture concepts- crack tip opening displacement- J using FEM.

UNIT V **9**

Fracture design- selection of materials-Fatigue crack growth rate curve- stress intensity factor range- Use of crack growth law.

TEXTBOOKS:

1. Jean lemative and Jean Louis chboche “Mechanics of solid Materials,” Cambridge university press, Cambridge, 1987.
2. Prashant Kumar, Elements of fracture mechanics, wheeler publishing, 1999.

REFERENCES:

1. David Broek- “Elementary engineering fracture mechanics” MartinusNijh off publishers, 1982.
2. John M.Barsom and Stanley T Rolfe, “Fracture and fatigue control in structures”, Prentice Hall, Inc, USA, 1987.
3. https://apm.iitm.ac.in/smlab/kramesh/book_4.htm

Course Coordinator **HOD**

Mr.Jose Ananth Vino **Dr. K. Balasubramanian**

U18PEME54	**PRINCIPLES OF MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Coordinator Name & Department – Dr.K.Balasubramanian Department of Mechanical Engineering				

OBJECTIVES

- amiliarize the students with the fundamental concepts of Management and to highlight the approaches in organization behavior.

COURSE OUTCOMES (COs)

CO1	Recall the concepts of Management
CO2	Illustrate Management Functions
CO3	ApplyOrganization Theory & Approach.
CO4	Categorize the Concepts of Motivation
CO5	Perceive the factors contributing to discipline
CO6	Formulate and compile the concepts of Group Behavior

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			3	3								
	CO2				3					3			
	CO3	1						3					
	CO4		1					3		2			
	CO5												
	CO6									2			
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT -I **9**

Definition – theory and practice – effective management – Management : Science of Art – Management in India. Development of Management thoughts – Taylor's – Henry Fayol – Hawthrone experiment – Barnard & Social system – Herbert Simon – Peter Drucker – Various approaches – Management thoughts.

UNIT- II **9**

Co-ordination – Functions of management – Managers and environment – External and internal Business Ethics – Planning – Fundamentals – Definitions & Features – Steps in planning – types of planning – Objectives – Concepts and features – Hierarchy of objectives – role – Process of MBO – Policy & Strategy – Decision making process – Individual Vs Group Decisions.

UNIT- III **9**

Organizing – Theory & Approach –Authority & Responsibility – Delegation – Centralization & Decentralization – Line & Staff Relationship – Staffing – Fundamentals – System approach – Manpower Planning – Recruitment & Selection – Training and development – Performance appraisal – Direction – Fundamentals Motivation – Theories of Motivation-Maslow's Hersberg's MaClelland's theory X,Y & Z leadership – Theories and Styles – Communication – Type – Controlling – System and Process.

UNIT- IV **9**

Definition – Organization – Managerial Role and Functions – Organizational Approaches, Individual behaviour – Causes – Environmental effect – Behaviour and performance, perception – Organizational implications, Personality – Contributing factors – Dimension, Motivation – Need Theories – Process Theories – Job satisfaction, Learning and Behaviour – Learning Curves, Work Design and Approaches.

UNIT -V **9**

Groups – Contributing factors –Group Norms, types – Causes – Intergroup relations – Conflict and Resolution – Change Process –Resistance to change.

TEXT BOOKS:

1. Herald Knootz and Heinz weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 2004.
2. Ties AF, Stoner and R. Edward Freeman, "Management" Prentice Hall of India Pvt. Ltd., New Delhi -110011, 1995.

REFERENCE BOOKS :

1. Joseph I. Massie 'Essentials of Management', Prentice Hall of India Pvt. Ltd., New Delh-110011, 2004.
2. Prasad L.M "Principles and Practice of Management", Sultan Chand & Sons.2001
3. Uma Sekaran, "Organizational Behaviour", Tata McGraw Hill, 2007
4. https://www.extension.harvard.edu

Course Coordinator **HOD**

Dr. K. Balasubramanian **Dr. K. Balasubramanian**

U18PEME61	**COMBUSTION ENGINEERING**									**L**	**T**	**P**	**C**
	Total Contact Hours – 45									3	0	0	3
	Prerequisite – IC ENGINES												
	Course Coordinator Name & Department – Mr.Manavalan , Department of Mechanical Engineering												
OBJECTIVES To understand and analyze the combustion with emphasis on engineering applications.													
COURSE OUTCOMES (COs)													
CO1	Understand various types of fuels and its ppts												
CO2	Students recalling the basic concept of gaseous fuels												
CO3	Will able to comparegaseous and liquid fuels												
CO4	Students are able to examinethe concept of solid fuels												
CO5	students will be able to explain the fluidized bed combustion												
CO6	students will be able to design and executethe fundamentals in combustion of fuels.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	I	j	k	l

2	CO1	3											
	CO2	3		3				1					
	CO3	3		3		2	2			1		1	
	CO4	3		3									
	CO5	3					2		2				
	CO6	3		3									
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

OBJECTIVES:

To acquire the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components

CONTENTS:

UNIT I **9**

Fuels and combustion, Theoretical and actual combustion processes, Enthalpy of formation and enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature, Entropy change of reacting systems, Second law analysis of reacting systems, problems

UNIT II **(9)**

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation

UNIT III **9**

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays

UNIT IV **9**

Drying of solid fuels, devolatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

UNIT V **9**

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, circulating fluidized beds, pressurized fluidized bed combustion, problems.

TEXTBOOK:

1. Yunus.A.Cengel- A textbook of Thermodynamics

REFERENCES:

1. Gary.L.Borman, Combustion Engineering-McGraw Hill international Edition,1998
2. Roger.A.Strehlow-Combustion fundamentals- McGraw Hill international Edition,1989.
3. www.goodreads.com/book/show/3785353-**combustion-engineering**

Course Coordinator **HOD**

Mr.Manavalan **Dr. K. Balasubramanian**

U18PEME62	**DESIGN OF HEAT EXCHANGERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – HEAT AND MASS TRANSFER				
	Course Coordinator Name & Department – Mr. S. Karthikeyan/Mechanical				

OBJECTIVES

To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications.

COURSE OUTCOMES (COs)

CO1	Studentswill be able to define the concepts and working principle of heat exchangers.
CO2	students will be able to explain heatexchanger design.
CO3	students will be able to calculate compact heatexchanger design.
CO4	students will be able to determine the concept of cooling tower.
CO5	students will be able to explain the SHELL type heat exchangers
CO6	students will be able discuss the use of other types of heat exchangers, advantages and disadvantages

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	K	l
2	CO1	3											
	CO2			3		1				3		1	2
	CO3	3					2						
	CO4			3		1		2					
	CO5									3			2
	CO6	3				1							
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **9**

Thermal And Hydraulic design – Inner pipe – Annulus, Hairpin heat exchanger – Basic inner tube – Finned multi tubes – Parallel and series arrangements – Pressure drop, Constructional features. Heat pipes – Structures – Applications – Basic relations – Performance characteristics – Effect of working fluid and operating temperatures, Wick – Selection of materials – bore size.

UNIT II **9**

Basic components – shell – tube bundles – baffles – type and geometry, design procedure – preliminary estimation of size, pressure drop and Heat transfer calculations – shell and tube sides – Kenn method – Bell – Delaware methods.

UNIT III **9**

Compact Heat Exchangers – types – constructional features, heat transfer and pressure drop calculations – Finned plate and tube.Gasketted plate Heat Exchangers - constructional features plate, pack and flame – Operational characteristics – Flow arrangements, Heat transfer and pressure drop calculations, Performance analysis, Comparison with other types of heat exchangers.

UNIT IV **9**

Shell and tube condensers – Horizontal and vertical types – Design and operational consideration, Plate condensers, Air cooled and direct contact type condenser for refrigeration, Evaporative condensers.Evaporators for refrigeration and air conditioning – Chillers – air coolers – thermal analysis – Shah, Kandhkar and Ghnkor and Winterom Correlations, Standard types.

UNIT V **9**

Cooling towers - Types – Basic relation – Heat balance and heat transfer characteristics and effect of packing – Geometry, Spray design, Selection of pumps, fans, testing, Maintenance, environmental effects, wind load, typical installations.

TEXTBOOK:

1. Rajput R.K- Heat and mass Transfer- S Chand Publications, Jan 2008

REFERENCES:

1. Arthur.P.Fraas, - Heat exchanger Design, John Willey & Sons, 1997.
2. Holger Martin - Heat exchangers – Hemi sphere Publishing Corporation, London.
3. Kenn.D, - Process heat transfer – Tata McGraw Hill, 1980.
4. SadikKakal&Homgton Lin – Heat Exchangers – CRC Press, London, 1998.
5. https://www.crcpress.com/**Heat-Exchanger-Design**-Hand**book**/.../978142...

Course Coordinator **HOD**

Mr. S. Karthikeyan **Dr. K. Balasubramanian**

U18PEME63	**RAPID PROTOTYPING**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course Coordinator Name & Department – Mr. Lenin Rakesh ,Department of Mechanical Engineering				

OBJECTIVES

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields.

COURSE OUTCOMES (COs)

CO1	Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.
CO2	Students will be exposed to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.
CO3	Students will learn and evaluate steriolithography methods and concepts for improvement.
CO4	Students recognize and learn processes in CAD
CO5	Students gain knowledge to build and analyse prototypes

CO6	Students will be able to apply and process newer techniques and improved methodologies												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	B	c	d	e	f	g	h	i	j	k	l
2	CO1	3											
	CO2	3		3	2					3			
	CO3			3			2						
	CO4	3		3					2			1	
	CO5	3											
	CO6												
3	Category	Professional Elective											
4	Approval	47th Academic Council, July 2018											

UNIT I **10**

Introduction - Basic operation –impact of rapid proto typing and tooling on product development- benefits-applications.

UNIT II **10**

Rapid Prototyping Processes: Introduction –Classification-laminated object manufacturing-fused deposition modeling-stereolithography-solid ground curing –selective laser sintering-3D printing

UNIT III **10**

CAD Processes: Introduction –data requirements-solid modeling –surface modeling .geometric processing –interface formats-model preparation-slicing, support structures and machine instructions

UNIT IV **5**

Materials for Rapid Prototyping: Plastics- resins -metals-ceramics selection of materials for suitable processes – advantages-limitations

UNIT V **10**

Rapid Tooling Processes: Introduction - Classification in direct rapid tooling-silicon rubber Moulding-epoxy Moulding-electro forming-vacuum casting-vacuum forming-rapid tools for injection Moulding – direct rapid cooling processes –SLS rapid tool- shape deposition manufacturing- laser deposition lamination-rapid tooling roots

TEXTBOOKS:

1. "Additive Manufacturing Technologies" by Ian Gibson and David Rosen
2. "Additive Manufacturing: Advanced Manufacturing Technology in 3d Print Deposit" by SabrieSoloman
3. "Design for Additive Manufacturing" by Dr Tom Page

4.Rapid Prototyping Principles and applications by Rafiq Noorani, John Wiley and Sons, Inc (R2)

REFERENCES :

1. Paul F. Jacobs, Rapid Prototyping and Manufacture. Fundamentals of Stereolithography,1995
2. Rapid News, University of Warwick. UK 1995
3. Rapid Prototyping by Chee kai Chua, KahfaiLeong, Chu Sing Lim, 3rd Edition, ebook.

4. Rapid Prototyping reports, CAD/CAM publishing ,1991

Course Coordinator **HOD**

Dr. K. Balasubramanian

U18PEME064	**PLANT LAYOUT AND MATERIAL HANDLING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Manufacturing Technology				
	Course Coordinator Name & Department – Mr. G. Sucharitha,Department of Mechanical Engineering				

OBJECTIVES

To equip students with adequate knowledge for running an organization and to understand the integration of material handling systems.

COURSE OUTCOMES (COs)

CO1	Understand the procedures for systematic integration of organization.
CO2	Students will be able to design various layouts for installing the industries are departments
CO3	Students will be able to choose the right material handling system to the right place.
CO4	Students will be able to make the models of buildings and other channels according to utilization.
CO5	Students will be able to analyze the safety, movement of material and man in the plant.
CO6	After completion of this course students able to describe the plant layout, material handling systems and different building utilities.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	G	H	i	J	K	l
2	CO1	3											

	CO2	3		3				1					
	CO3	3		3		2	2			1		1	
	CO4	3		3									
	CO5	3					2		2				
	CO6	3		3									
3	Category	Professional Elective											
4	Approval	47th Meeting of Academic Council, July 2018											

UNIT I **8**

Plant Location: Factors to be considered – influence of location on plant layout, selection of plant site, Consideration in facilities planning and layout. Equipments required for plant operation, Capacity, serviceability and flexibility and analysis in selection of equipments, space requirements, and man power requirements.

UNIT II **8**

Plant layout: Need for layout, types of layout, factors influencing product, process. Fixed and combination layout: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure.Visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

UNIT III **10**

Importance and scope.Principles of material handling. Planning, operating and costing Principles, types of material handling systems, factors influencing their choice. Assembly practices: Manufacturing and assembly, process planning, selective assembly.

UNIT IV **12**

Industrial building and utilities: Centralized electrical, pneumatic water line systems. Types of buildings, lighting, heating, air conditioning and ventilation utilities - planning and maintenance, waste handling, statutory requirements. Packing and storage materials: Importance of Packaging, layout for Packaging – Packaging machinery – wrapping and Packing materials, cushion materials.

UNIT V **7**

Motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys.

TEXT BOOKS :

1. Agarwal, Plant layout and material handling, Jain brothers publication.
2. Sharma S.C, Plant layout and material handling, Khanna publishers.

REFERENCES :

1. Oberman. Ya, Material handling, Mir publishers.1980
2. Sharma S.C, Material Management And Material Handling, Khanna Publishers.1995.
3. Shubin J A, Plant layout, P H I publications.1965
4. https://books.google.com/.../**Plant_Layout_and_Material_Handling**.html?...

Course Coordinator
Mr. G. Sucharitha

HOD
Dr. K. Balasubramanian

OPEN ELECTIVES

U18OEME001	**DESIGN FOR MANUFACTURING AND ASSEMBLY**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course Coordinator Name & Department – Mr. Arun Rejus/Department Mechanical Engineering				
Approval	47th Academic Council, July 2018				

SYLLABUS

Unit 1
Introduction Need Identification and Problem Definition, Concept Generation andEvaluation, Embodiment Design, Selection of Materials and Shapes

Unit 2
Properties of Engineering Materials, Selection of Materials – I, Selection of Materials – II,Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II,

Unit 3:
Selection ofManufacturingProcesses, Review of Manufacturing Processes, Design forCasting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy,Design for Polymer Processing, Co-selection of Materials and Processes, Case-Studies – III

Unit 4

Design for Assembly, Review of Assembly Processes, Design for Welding – I, Design forWelding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies – IV

Unit 5

Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality,Design for Reliability, Approach to Robust Design, Design for Optimization,

REFERENCES

1. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 03.
2. G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 00.
3. M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999.
4. T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY, 00.
5. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
6. S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
7. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
8. J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.
9. Houldcroft, Which Process – an introduction to welding and related processes and guide to their selection, Cambridge, Abington Pub., 1990.
10. ASTM Design handbook.

Course Coordinator **HOD**

Mr. Arun Rejus **Dr. K. Balasubramanian**

U18OEME002	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite –				
	Course Coordinator Name & Department – Mrs.G.Sucharitha /Mechanical				
Approval	47th Academic Council, July 2018				

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering,Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reductionmethods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need andapplications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing,cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Coordinator **HOD**

Dr. K. Balasubramanian

Mrs.G.Sucharitha

U18OEME003	**REFRIGERATION AND CRYOGENICS**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite –				
	Course Coordinator Name & Department – Mr.J.Manikandan,Departmen Mechanical Engineering				
Approval	47th Academic Council, July 2018				

Unit I

Vapour compression refrigeration, actual cycle, second law efficiency,

Unit II

Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems,

Unit III

Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor,

Unit IV

Design, selection of evaporators, condensers, control systems, motor selection, Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,
Refrigeration applications, food preservation, transport,

Unit V

Introduction to Vapor absorption refrigeration, single effect and double effect systems, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle.

References:

1. R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2001.
2. C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
3. Stoecker& Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, New York, 1982.
4. Jordan & Priester, "Refrigeration and Air-conditioning".
5. A.R.Trott, "Refrigeration and Air-conditioning", Butterworths, 2000.
6. J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.
7. R.Barron, "Cryogenic systems", McGraw–Hill Company, New Yourk, 1985.
8. G.G.Hasseldon. "Cryogenic Fundamentals", Academic Press.
9. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.
10. W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
11. John A.Corinchock, "Technician's Guide to Refrigeration systems", McGrawHill.
12. P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan, 1992.
13. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
14. Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics", Clarendon Press, 1989

Course Coordinator **HOD**

Dr. K. Balasubramanian

Mr.J.Manikandan

U18OEME004	**PRODUCTION DESIGN & DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite –				
	Course Coordinator Name & Department – Dr.V.Balambica,Department Mechanical Engineering				
Approval	47th Academic Council, July 2018				

SYLLABUS

UNIT – I FUNDAMENTALS OF DESIGN 9

Product development – marketing design & production – design process – morphology of design – Asimov's models – problem statement – product design specification – concept selection techniques.

UNIT – II PRODUCT STRATEGIES 9

Product strategies – product analysis – standardization, simplification & specialization – creativity – aesthetics – ergonomics – functional design – hierarchy of needs – needs analysis.

UNIT – III ECONOMIC ANALYSIS 9

Customer & competitors – product value – economic analysis – qualitative & quantitative analysis – profit consideration – break even analysis – profit volume charts.

UNIT – IV PRODUCT ARCHITECTURE 9

Product architecture – modularity – product change – product variety – component standardization – performance – manufacturability – establishing the architecture – variety & supply chain – platform planning.

UNIT – V INDUSTRIAL PRACTICES 9

Conventional practices – recent trends – technology & user driven products advertisements – patents – case studies.

Reference:

1. G.E Dieter – Engineering Design –Mc Graw Hill, 1991.
2. Kart.T. Ulrich, Steven .D. Eppinger – product design & development – Mc Graw Hill, 2000.
3. Chitale. Gupta – product design &Mfg – Prentice Hall 1997.

Course Coordinator **HOD**

Dr.V.Balambica

Dr. K. Balasubramanian

CURRICULUM AND SYLABUS (R2018)

B-FACT:: Flexible **A**ccommodative **C**redit system for **T**echnology

(Applicable to the batches admitted from July 2018)

B.Tech – MECHATRONICS

FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
3	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
8	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
9	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
10	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	35	15	1	19	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics-II	4	3	1	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
8	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
9	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	18MCAB203	MC	Yoga	2	0	0	2	0
11	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	17	2	17	25.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER III								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA302	BS	Partial Differential Equations and Probability &Statistics	4	3	1	0	4
2	U18PCMT301	PC	Kinematics of Machines	4	3	1	0	4
3	U18PCMT303	PC	Fundamentals of Electronic Circuits and Devices	3	3	0	0	3
4	U18PCMT304	PC	Measurement and Instrumentation	3	3	0	0	3
5	U18ESEC302	PC	Digital Electronics	3	3	0	0	3
6	U18PCMT306	PC	Electrical Machines & Drives	3	3	0	0	3
PRACTICAL								
7	U18PCMT3L1	PC	Electronic Circuits and Devices - Lab	2	0	0	2	1
8	U18PCMT3L2	PC	Electrical Machines & Drives Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage(Festivals, Food ways, Local games)	2	0	0	2	0
Total				28	18	2	8	22

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA401	BS	Numerical Methods	3	3	0	0	3
2	U18PCMT402	PC	Dynamics of Machines	4	3	1	0	4
3	U18PCMT403	PC	Manufacturing Technology	3	3	0	0	3
4	U18PCMT404	PC	Power Electronics	3	3	0	0	3
5	U18PCMT405	PC	Control Systems	4	3	1	0	4
6	U18PCMT406	PC	Transducer Engineering	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
8	U18PCMT4L1	PC	Machine Dynamics Lab	2	0	0	2	1
9	U18PCMT4L2	PC	Sensors and Instrumentation Lab	2	0	0	2	1
10	U18EEMT4L3	EE	Technical Seminar	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
Total				32	20	2	10	23

SEMESTER V								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCMT501	PC	Microcontroller & PLC	4	3	1	0	4
2	U18PCMT502	PC	CNC Technology	3	3	0	0	3
3	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
4	U18PCMT503	PC	Integrated Circuits	3	3	0	0	3
5	U18PEMT5E1	PE	Professional Elective – I	3	3	0	0	3
6	U18PEMT5E2	PE	Professional Elective – II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
8	U18PCMT5L1	PC	Microcontroller & PLC Lab	2	0	0	2	1
9	U18PCMT5L2	PC	CNC Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB509	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
11	U18MCAB510	MC	Self-Development - religion and Inter-faith	2	0	0	2	0
			Total	29	20	1	8	21

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA601	BS	Operations Research for Engineers	3	3	0	0	3
2	U18PCMT601	PC	Applied Hydraulics & Pneumatics	4	3	1	0	4
3	U18PEMT6E3	PE	Professional Elective – III	3	3	0	0	3
4	U18PEMT6E4	PE	Professional Elective – IV	3	3	0	0	3
5	U18OEMT6E1	OE	Open Elective-I	3	3	0	0	3
6	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
7	U18PCMT6L1	PC	CAD/CAM Lab for Mechatronics	2	0	0	2	1
8	U18PCMT6L2	PC	Hydraulics & Pneumatics Lab	2	0	0	2	1
9	U18EEMT6S1	EE	Soft Skill	2	0	0	2	1
10	U18EEMT6I1	EE	Summer Internship	2	0	0	2	1
ACTIVITY BASED COURSES								
11.	U18MCAB609	MC	Social Services – Social Awareness	2	0	0	2	0
12.	U18MCAB610	MC	Social Services – NSS	2	0	0	2	0
			Total	30	17	1	11	20

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCMT701	PC	Robotics & Machine Vision System	3	3	0	0	3
2	U18PCMT702	PC	Design of Mechatronics system	3	3	0	0	3
3	U18PEMT7E5	PE	Professional Elective – V	3	3	0	0	3
4	U18OEMT7E2	OE	Open Elective -II	3	3	0	0	3
5	U18OEMT7E3	OE	Open Elective – III	3	3	0	0	3
PRACTICAL								
6	U18PRMT7P1	EE	Project Stage-I	6	0	0	6	3
7	U18PCMT7L1	PC	Robotics Lab	2	0	0	2	1
8	U18PCMT7L2	PC	Simulation and Programming Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB713	MC	Behavioral and Interpersonal Skills	2	0	0	2	0
10	U18MCAB714	MC	Nature – Nature Club	2	0	0	2	0
			Total	29	12	0	14	20

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCMT801	PC	Biomedical Instrumentation for Mechatronics	3	3	0	0	3
2	U18PEMT8E6	PE	Professional Elective – VI	3	3	0	0	3
3	U18OEMT8E4	OE	Open Elective – IV(Mooc)	3	2	0	0	2
PRACTICAL								
4	U18PRMT8P2	EE	Project Work-II	18	0	0	18	9
5	U18PCMT8C1	EE	Comprehension	1	0	0	1	1
ACTIVITY BASED COURSES								
6	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total				27	7	0	21	18

Professional Elective- I

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT011	Electronics	Communication Engineering	3	0	0	3
U18PEMT012	Mechanical	Mechanics of Solids and Fundamentals of Fluids	3	0	0	3
U18PEMT013	Mechatronics	Virtual Instrumentation	3	0	0	3
U18PEMT014	Automation	Process Automation	3	0	0	3

Professional Elective – II

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT021	Electronics	Consumer Electronics	3	0	0	3
U18PEMT022	Mechanical	Dimensional Metrology	3	0	0	3
U18PEMT023	Mechatronics	Textile Mechatronics	3	0	0	3
U18PEMT024	Automation	Plant Layout and Material Handling	3	0	0	3

Professional Elective – III

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT031	Electronics	Neural Network & Fuzzy Logic	3	0	0	3
U18PEMT032	Mechanical	Composite Materials and Structure	3	0	0	3
U18PEMT033	Mechatronics	Underwater Robotics	3	0	0	3
U18PEMT034	Automation	Building Automation	3	0	0	3

Professional Elective – IV

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT041	Electronics	Digital Signal Processing	3	0	0	3
U18PEMT042	Mechanical	Unconventional Machining Processes	3	0	0	3
U18PEMT043	Mechatronics	Cognitive Robotics	3	0	0	3
U18PEMT044	Automation	Industrial Automation	3	0	0	3

Professional Elective – V

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT051	Electronics	Digital Image Processing	3	0	0	3
U18PEMT052	Mechanical	Rapid Prototyping	3	0	0	3
U18PEMT053	Mechatronics	Internet of Things for Mechatronics	3	0	0	3
U18PEMT054	Automation	Vetronics	3	0	0	3

Professional Elective – VI

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT061	Electronics	Embedded System Design	3	0	0	3
U18PEMT062	Mechanical	Total Quality Management	3	0	0	3
U18PEMT063	Mechatronics	Micro Electronics and Nano Electronics	3	0	0	3
U18PEMT064	Automation	Computer Integrated Manufacturing	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion

41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS001-Mobile Application Development
72. U18OECS002-System Modelling and Simulation
73. U18OECS003-Web Programming
74. U18OECS004-Virtual Reality
75. U18OECS005- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	Communicative English	4	2	0	2	3
2	U18HSEN201	Technical English	3	1	1	0	3
3	U18HSBA501	Organizational Behavior	3	3	0	0	3
Total Credits							9

BASIC SCIENCE (BS)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18BSMA101	Engineering Mathematics –I	4	3	1	0	4
2	U18BSPH 101	Waves and Optics	3	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	3	0	0	3
4	U18BSMA201	Engineering Mathematics- II	4	3	1	0	4
5	U18BSPH201	Introduction to Mechanics	3	3	0	0	3
6	U18BSCH201	Environmental Sciences	3	3	0	0	3
7	U18BSBT101	Biology for Engineers	2	2	0	0	2
8	U18BSMA302	Partial Differential Equations and Probability &Statistics	4	3	1	0	4
9	U18BSMA401	Numerical Methods	3	3	0	0	3
10	U18BSMA601	Operations Research for Engineers	3	3	0	0	3
10	*U18BSPH2L1	Wave Optics and Mechanics Lab	3	0	0	3	1.5
11	*U18BSCH2L4	Chemistry Lab	3	0	0	3	1.5
Total Credits							35

ENGINEERING SCIENCE COURSES (ES)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18ESCS101	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	Engineering Graphics & Design	5	1	0	4	3
3	U18ESEE101	Basic Electrical & Electronics Engineering	3	3	0	0	3
4	U18ESCS1L1	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
5	U18ESME1L2	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
6	U18ESEE1L3	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
						Total	15

PROFESSIONAL CORE COURSES(PC)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18PCMT301	Kinematics of Machines	4	3	1	0	4
2	U18PCMT303	Fundamentals of Electronic Circuits and Devices	3	3	0	0	3
3	U18PCMT304	Measurement and Instrumentation	3	3	0	0	3
4	U18ESEC302	Digital Electronics	3	3	0	0	3
5	U18PCMT306	Electrical Machines & Drives	3	3	0	0	3
6	U18PCMT 402	Dynamics of Machines	4	3	1	0	4
7	U18PCMT 403	Manufacturing Technology	3	3	0	0	3
8	U18PCMT404	Power Electronics	3	3	0	0	3
9	U18PCMT 405	Control Systems	4	3	1	0	4
10	U18PCMT 406	Transducer Engineering	3	3	0	0	3

11	U18PCMT501	Microcontroller & PLC	4	3	1	0	4
12	U18PCMT502	CNC Technology	3	3	0	0	3
13	U18PCMT503	Integrated Circuit	3	0		0	3
14	U18PCM 601	Applied Hydraulics & Pneumatics	4	3	1	0	4
15	U18PCMT701	Robotics & Machine Vision System	3	3	0	0	3
16	U18PCMT702	Design of Mechatronics system	3	3	0	0	3
	U18PCMT703	Computer Integrated Manufacturing	3	3	3	0	3
17	U18PCMT3L1	Electronic Circuits and Devices - Lab	2	0	0	2	1
18	U18PCMT3L2	Electrical Machines & Drives Lab	2	0	0	2	1
19	U18PCMT4L1	Machine Dynamics Lab	2	0	0	2	1
20	U18PCMT4L2	Sensors and Instrumentation Lab	2	0	0	2	1
21	U18PCMT5L1	Microcontroller & PLC Lab	2	0	0	2	1
22	U18PCMT5L2	CNC Lab	2	0	0	2	1
23	U18PCMT6L1	CAD/CAM Lab	2	0	0	2	1
24	U18PCMT6L2	Hydraulics & Pneumatics Lab	2	0	0	2	1
25	U18PCMT7L1	Robotics Lab	2	0	0	2	1
26	U18PCMT7L2	Simulation and Programming Lab	2	0	0	2	1
						Total Credits	66

EMPLOYABILITY ENHANCEMENT (EE) COURSES

S.NO	Code No.		Course Title	Contact Periods	L	T	P	C
1	U18EEMT4L3	EE	Technical Seminar	2	0	0	2	1
2	U18EEEA6L2	EE	Soft Skill	2	0	0	2	1
3	U18EEMT6L3	EE	Summer Internship	2	0	0	2	1
4	U18EEMT7P1	EE	Project Work-I	6	0	0	6	3
5	U18EEMT8P2	EE	Project Work-II	18	0	0	18	9
6	U18EEMT8C1	EE	Comprehension	1	0	0	1	1
		Total Contact Hours		31	0	0	31	16

MANDATORY COURSES (MC)

S.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18MCTH401	Constitution of India	2	2	0	0	0
2	U18MCTH502	Universal Human Values	2	2	0	0	0
3	U18MCTH603	Essence of Indian Knowledge Tradition	2	2	0	0	0
4	U18MCAB101	Physical health – Sports & Games	2	0	0	2	0
5	U18MCAB102	Gardening & Tree Plantation -	2	0	0	2	0
6	18MCAB203	Yoga	2	0	0	2	0
7	18MCAB204	Physical health – NCC	2	0	0	2	0
8	U18MCAB305	Culture- Learning an art form	2	0	0	2	0
9	U18MCAB306	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
10	U18MCAB407	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	Literature & Media – Group Reading of Classics	2	0	0	2	0

12	U18MCAB509	Social Services – Social Awareness	2	0	0	2	0
13	U18MCAB510	Social Services – NSS	2	0	0	2	0
14	U18MCAB611	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
15	U18MCAB612	Self Development - religion and Inter-faith	2	0	0	2	0
16	U18MCAB713	Behavioral and interpersonal skills	2	0	0	2	0
17	U18MCAB714	Nature – Nature club	2	0	0	2	0
18	U18MCAB815	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total Contact Hours			36	6	0	30	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No.	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences (HS)	3	3	-	-	3	-	-	-	9	5%
2	Maths& Basic Sciences (BS)	10	15	4	3	-	3	-	-	35	21%
3	Engineering Sciences (ES)	7.5	7.5	-	-	-	-	-	-	15	9%
4	Professional Core (PC)	-	-	18	19	12	6	8	3	66	39%
5	Professional Electives (PE)	-	-	-	-	6	6	3	3	18	11%
6	Open Electives/ MOOC (OE)	-	-	-	-	-	3	3	5	11	6%
7	Employability Enhancement Courses (EE) Project Work, Seminar, Internship, Term Paper, etc.	-	-	-	1	-	2	3	10	16	9%
8	Mandatory course(MC)	0	0	0	0	0	0	0	0	0	0
	Total Credit	20.5	25.5	22	23	21	20	17	21	170	100%
	Total Contact Hour	35	36	28	32	29	30	29	27	246	246

TOTAL CREDITS=170

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 30

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion

2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. **Practical English Usage. Michael Swan. OUP. 2005.**
6. **Remedial English Grammar. F.T. Wood. Macmillan.2007**
7. **On Writing Well. William Zinsser. Harper Resource Book. 2001**

COURSE OUTCOMES (COs)	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M										M	
	CO2		H							H			
	CO3			M							M		
	CO4				M		H						M
	CO5					M		M	L				
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSMA101	Engineering Mathematics – I	L	T	P	C
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES												
COs \POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	S				M		W			W		
2	S		S	W	M			M				M
3	S				M				W			
4	S	M			M				W		W	
5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS **9**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A & B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) Brij Lal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) Ajoy Ghatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES

COs/POs	a	b	c	d	e	f	g	h	i	j	**k**	**l**
1	S	S	M	S	M			M	S	S		M
2	W	S	M	M	S			M		W	S	S
3	S	W			W			M	M		M	W
4	S	W			W			M	M		M	W

5		S	M	M	M				M		S	W	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH101	ENGINEERING CHEMISTRY	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non-ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke – manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			M		M		M		L		M
	CO2		L	M		H		M		H		L	
	CO3		H		S		L				H		L
	CO4	M		H	L			M			M		
	CO5		M		L		H				M		H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

2. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	S	M	S	M	W		M	W	M	S
	CO2	S	S	M	M		M		W			M	M
	CO3	M	M	W	S	M		W		W		M	W
	CO4	M	M	W	M	S	M	W	M	W		M	W
	CO5	M	S	W	M	M			M	M	W		W
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).
(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)
Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)
Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE4: SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)
Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)
Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)
Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale –Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views

of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H			M					
	CO2	M	M	L		L	H						L
	CO3			M									M
	CO4											M	
	CO5	M						L					
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSPH2L1	**WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	L	T	P	C
		0	0	3	1.5
	Total Contact Hours - 45				
	Prerequisite – **Wave Optics and Mechanics**				
	Course designed by – Department of Physics				
OBJECTIVES: To impart Practical knowledge of Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

Course Outcome (CO's)													
CO1	Understand the fundamental concept of optics												
CO2	Understand the concept of production of ultrasonic waves												
CO3	Understand the basic concept of Mechanics												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S		S	S				S	W	M		
	CO2	S	S	W					S	W	M		S
	CO3	S	S	W					S	M	M	M	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method

2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Studentswill be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Students will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	M		H		H		L		
	CO2	L	H			M		H		M		L	
	CO3		M		M						M		H
	CO4	H		M				M				H	
	CO5		H		L		M				H		
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	S	M	M	M	M		M	S
	CO2	S	S	W	S	S	M	W	M	M	M	M	S
	CO3	S	S	M	M	M	M		M	M	M	M	M
	CO4	S	M	S	S	S	M	M	M	M	W		S
	CO5	S	S	M	S	M	M		M	M	W	M	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

	TECHNICAL ENGLISH	**L**	**T**	**P**	**C**
U18HSEN201	Total Contact Periods – 45	2	1	0	3

	Prerequisite – I semester English
	Course Designed by – Department of English
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)	
CO1	The student will acquire basic proficiency in English

CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M										H	
	CO2		H							M			
	CO3			H							H		H
	CO4				M		H						
	CO5					M		M	M				
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSMA201	**Engineering Mathematics II (Common to B.Tech – Civil, Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, ECE, BME, CSE & IT)**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without

proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method – Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs \POs	**Programme Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	M		W		S				M		S	M
CO2	S	M			S			M		W		
CO3	S		W				M		S			S
CO4								S	M	M	W	M
CO5	S		W	W			M				S	
Cate	Basic Science (BS)											

App	47th Academic Council Meeting held in Aug, 2018

U18BSPH201	INTRODUCTION TO MECHANICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart basic knowledge of mechanics involving 1D, 2D and 3D motions ofa rigid body

UNIT 1 **9**

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2 **9**

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3 **9**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4 **9**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5 **9**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.

2. M.K. Harbola, “Engineering Mechanics”, 2nd edition, Cengage, 2013.

3. M.K. Verma, “Introduction to Mechanics”, 1st edition, CRC press, 2009.
4. D.Kleppner&R.Kolenkow, “An Introduction to Mechanics”, McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, “Engineering Mechanics – DynamicsVol 2”, 7th ed. Wiley, 2012
6. JP Den Hartog, “Mechanical Vibrations”, Dover Publications, Inc., 1985
7. WT Thomson, “Theory of Vibrations with Applications”, Pearson, 5th edition, 1997.
8. Online References: Wikipedia org

Course Outcomes

COURSE OUTCOMES (COs)	
CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			L	L					M		W	
	CO2	H		L	L	H				M		L	
	CO3	M				M				H		M	
	CO4	H		L	L					M		L	
	CO5	L		H	H	M				M		L	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel – oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering‘, Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards‘, Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure’, Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, “Basics of Civil Engineering”.

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law‘, Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		
	CO4	H		M	L			M				M	H
	CO5		H		L		M				H		
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector					

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure
CO2	To understand about biodiversity and its conservation
CO3	To know the fundamentals of genetics and the immune system

CO4	To create an awareness about human diseases												
CO5	To give a basic knowledge of the applications of transgenics												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M	M			H	M	H
	CO2	H			M		H		M	M			H
	CO3	M		M			M						M
	CO4							H			M	M	
	CO5	H	H					H	M	M			H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC

Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS 6

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	**COURSE OUTCOMES (COs)**
CO2	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO3	To gain knowledge regarding fundamentals of AC circuits.
CO4	To gain knowledge regarding electrical machines and transformers.
CO5	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	L			M				H		L	H
	CO2	H	L			M				H		L	H
	CO3	H	M			M				H		L	H
	CO4	H	L			M				H		L	H

	CO5	H	L			M				H		L	H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESME1L2	**Workshop/Manufacturing Practices Laboratory**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice
2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.
3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**
a) Forming &Bending:
b) Model making–Trays, funnels, etc.
c) Different type of joints

6. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.

2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	**COURSE OUTCOMES (COs)**
CO2	Students will gain knowledge of the different manufacturing processes.
CO3	Students will be able to fabricate components with their own hands.
CO4	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO5	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1											H	
	CO2			H	M							H	
	CO3		M										
	CO4	H			L							H	H
	CO5											H	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To handle basic electrical equipment and verify current and voltage law
CO3	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits
CO4	To understand domestic wiring procedures practically.
CO5	To analyze ac signal parameters using cathode ray oscilloscope and function generator

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H				H		M	H
	CO2	H	H			H				H		M	H
	CO3	H	H			H				H		M	H
	CO4	H	H			H				H		M	H
	CO5	H	H			H				H		M	H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

SEMESTER-III

U18BSMA302	**Partial Differential Equations, Probability and Statistics**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVE	Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms. Learn techniques of solving the standard types of first order and second order partial differential equations. Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem. Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases. Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample				

UNIT I FOURIER SERIES (9+3) Hrs

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS

(9+3) Hrs

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3) Hrs

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT 1V PROBABILITY DISTRIBUTION (9+3)Hrs

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS (9+3)Hrs

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. S.C.Gupta& V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi , 2003. [Units I to III].

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability for Engineers" , 6th Edn. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.
CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.

CO5	Learn the basic idea of statistics including measures of central tendency .Identify the appropriate hypothesis testing procedure based on type of outcome variable and number of samples.												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M				H	M	L	L	M			
	CO2	M	H	L		H	M	L			M	M	
	CO3	H	H	M	L				L		L		

U18PCMT301	**KINEMATICS OF MACHINES**										**L**	**T**	**P**	**C**
	Total Contact Periods – 60										3	1	0	4
	Prerequisite – Engg Mathematics-I, Engg Mathematics-II, Basic Mechanics													
	Course Designed by – Department of Mechatronics													
OBJECTIVES	To understand the various concepts in kinematics of various machines and mechanisms.													
	CO4	H	H	M	L			L		M		H		
	CO5	H	H		L		M	L	L			H		
3	Category	Professional Core(PC)												
4	Approval	47th Academic Council, July 2018												

UNIT I INTRODUCTION TO MECHANISMS 12

Introduction-Science of mechanisms-Terms and definitions-Planar, Spherical and spatial mechanisms, Mobility-Classification of mechanisms-Indexing mechanisms, reciprocating mechanism etc. Straight line generators- kinematic inversion- Slider crank chain inversions- Four bar chain inversions- Grashof's law.

Determination of velocities and acceleration in mechanisms- Relative motion method (Graphical) for Mechanisms having turning, sliding and rolling pair.

UNIT II SYNTHESIS OF MECHANISMS 16

Classification of kinematics- Synthesis problems- Chebyshev's spacing, Two point synthesis-Freudenstein method- Four bar mechanism and slider crank mechanism.

Types of cams and followers- Follower motions- Uniform, parabolic, SHM, Cycloidal and polynomial-Synthesis of cam profiles for different followers. Cams with specified contours

UNIT III FRICTION 10

Friction-Types-Application-Inclined plane, Screw jack, Clutch, Brakes Bearings, Journal bearing, Flat pivot bearing, multi collar bearings Belt drives.

UNIT IV THEORY OF GEARING 12

Classification of gears, Law of gearing, nomenclature-Forms of teeth, Cycloidal teeth, Involute teeth-Length of path of contact-Length of arc of contact-Contact ratio-Interference and undercutting- Minimum number of teeth to avoid interf
erence- Internal gears- Extended center distance system- Long and short addendum system- Gear trains-Types-Epicyclical gear trains-Automobile differential unit.

UNIT V CONTROL MECHANISMS 10

Governors- Gravity controlled governors-Spring control governors, Hartnell governor, and Hartung governor-Governor characteristics- Governor effort and power.

Gyroscopes-Gyroscopic forces and couple- Forces on bearing due to gyroscopic action-Gyroscopic effects on the movement of aero plans and ships, stability of two wheel drive and four wheel drive, Gyroscopic effects in grinding machines.

TEXT BOOKS

1. S.S.Rattan-Theory of Machines- Tata McGraw Hill, 4th Edition, 2014.
2. Dr.R.K.Bansal," Theory of Machines", Laxmi Publications Pvt. Ltd,5th Edition,2015.

REFERENCES

1. R.S.Kurmi,Theory of Machines,S.chand,2005
2. V.Ramamurti,"Mechanics of Machines"3rd Edition,Narosa Publications,2010
3. Shigley.J.E-Theory of Machines and Mechanisms, 4th Edition- Oxford,2014
4. V.P.Singh-Theory of Machines ,Dhanapat Rai,3rd Edition,2013
5. Rao J.S. &DukkipattiR.V.,"Mechanisms and Machine Theory", 2nd Edition-Wiley Estern Ltd-1992.

COURSE OUTCOMES (COs)	
CO1	Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design
CO2	Will know the impact of numerical methods in engineering analysis
CO3	Better understanding on the theoretical background of mechanisms
CO4	Will get the confidence in using mechanisms
CO5	Capability of solving engineering problems will increased

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		L	M		M	L	H			H
	CO2	H							L		M	L	
	CO3		H					M		H	M	L	H
	CO4				L	M		L	L		M	L	
	CO5	H	H		L					H			H
3	Category	Professional Core(PC)											

4	Approval	47th Academic Council, July 2018	

U18PCMT303	**FUNDAMENTALS OF ELECTRONIC CIRCUITS AND DEVICES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basic Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of semiconductors and the working of semiconductor based circuits				

UNIT I SEMICONDUCTOR THEORY AND SPECIAL DEVICES 9

SEMICONDUCTOR DIODES: Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

SPECIAL DIODES : Tunnel diodes – PIN diode, varactor diode — UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

UNIT II-TRANSISTOR CONFIGURATIONS 9

Transistor construction and operation - characteristics of CB, CC and CE configurations – Transistor amplifying action – Limits of operation - Transistor biasing: Operating point, load line analysis of fixed bias circuit - Darlington connection.

UNIT III - FEEDBACK AMPLIFIERS AND WAVE SHAPING CIRCUITS 9

Basic concepts of feedback- Four types of negative feedback – Effect of feedback on input resistance, output resistance- Voltage gain and current gain- Advantages of negative feedback- RC wave shaping circuits- Diode clippers and clampers- Voltage multipliers.

UNIT IV OSCILLATORS AND MULTIVIBRATORS 9

Oscillators: Classification of oscillators – Barkhausen criterion,Working of RC phase shift, Wien's bridge, Hartely, colpitts oscillators.

Multivibrators: Astable, monostable and bistable – Analysis of performance parameters of multivibrators ,Schmitt Trigger, Blocking oscillators.

UNIT V RECTIFIERS AND POWER SUPPLIES 9

Single –phase, half-wave and full-wave rectifiers – Bridge rectifiers – Ripple factor, rectification efficiency-Transformer Utilisation Factor and regulation – Performance characteristics of rectifiers with filters – Regulated power supply – Series and shunt type voltage regulators – Switched mode power supplies.

TEXT BOOKS

1. PROFESSIONAL ELECTIVERobert L.Boylestad& Louis Nashelsky,"Electronic Devices and Circuit Theory", Pearson India Education Services Pvt, 11th Edition,2015
2. K. Rama Sudha, K. VenkataRao, "Electronic Devices and Circuits ",Tata McGraw Hill ,1st Edition,2015
3. Thomas L.Floyd,"Electronic Devices "Pearson Education,10th Edition,2018.

REFERENCE

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7thEdtion, 2006.
2. Mahesh B.Patil,"Basic Electronic Devices and Circuits ", PHI Learning Pvt, 2013.
3. .J. Millman&Halkins, SatyebrantaJit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).
5. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).

COURSE OUTCOMES (COs)	
CO1	Able to get the knowledge about the working of semiconductors and Special diodes
CO2	Able to get the knowledge about the different configurations of transistors.
CO3	To learn about the concept of amplification and wave shaping circuits.
CO4	Able to get the basic concepts of Oscillators and Multivibrators.
CO5	To understand the working principle of Rectifiers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L						M
	CO2		L		M	H	L				H	L	
	CO3						M	M	M	M			M
	CO4	M	L		M	H		L			L	L	
	CO5	M					L	M				L	M
3	Category	Professional core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT304	**MEASUREMENT AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basic Electrical & Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To increase the ability of the students to model and analyze electrical apparatus and their application to power system				

UNIT I INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve

and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARISON METHODS OF MEASUREMENTS 9

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges.Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic interference – Grounding techniques.

UNIT IV STORAGE AND DISPLAY DEVICES 9

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

TEXT BOOKS

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements &Instrumentation' Dhanpat Rai and Co 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi,2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCE

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

COURSE OUTCOMES (COs)	
CO1	To introduce the basic functional elements of instrumentation
CO2	To introduce the fundamentals of electrical and electronic instruments
CO3	To educate on the comparison between various measurement techniques
CO4	To introduce various storage and display devices
CO5	To introduce the various classifications of transducers

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L				L	
	CO2		L					L	M	L	M		H
	CO3	M										M	
	CO4		L	L	M				M	M	M		L

	CO5	M			M	H		L					M
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEC302	DIGITAL ELECTRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Basic Electronics Knowledge				
	Course Designed by – Department of Mechatronics Engineering				

OBJECTIVES

- To get a basic understanding of how circuits and systems are designed with digital electronic circuit elements.
- To be able to analyze and design circuits and systems made from digital electronic circuit elements such as gates and flip-flops.
- To master basic design and programming.

UNIT-I NUMBER SYSTEMS AND CODES 9

Review of binary, octal and Hexa decimal representations of numbers and their conversion, Binary arithmetic; conversion algorithms.Weighted binary codes.Non weighted binary codes error-detecting and error-correcting codes-Alphanumeric codes.

UNIT-II BOOLEAN ALGEBRA 9

Introduction to Boolean algebra- The AND, OR and not operations. Laws of Boolean algebraof Boolean expressions. Boolean expressions and logic diagrams.Universal building blocks.Negative logic.

UNIT-III COMBINATIONAL LOGIC9

Truth tables and maps.Sum of products and product of sums; Map reduction hybrid functions.Incompletely specified functions.Multiple- Output minimization. Variable- Entered maps. Tabular minimization.Analysis of logic schematics.Synthesis of combinational functions.

UNIT-III LOGIC FUNCTION RELIZATION WITH MSI CIRCUITS 9

Multiplexers, De-multiplexers,Decoders and code converters. Arithmetic circuits, Adder, Number complements. Subtracting positive binary numbers with adders.Signed number addition and subtraction.

UNIT-IV SYNCHORONOUS SEQUENTIAL CIRCUITS 9

Basic latch circuits, De-bouncing switch. Flip-flops, truth table and excitation table. Shift registers. Asynchronous and synchronous counters. Shift counters.

UNIT-V ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis and Design of Asynchronous Sequential Circuits , Reduction of State and Flow Tables ,Race-free State Assignment, Hazards.

TEXT BOOKS:

1. T. L Floyd & Jain, “Digital fundamentals”, Pearson Education,3rd edition,2011.
2. Morris Mano M., “Digital Logic and Computer Design”, Pearson Education,2010.

REFERENCE BOOKS:

1. Heiser Man, “Digital IC applications”, Pearson Education,2007.
2. Raj Kamal, “Digital Systems Principles and Design”, Pearson Education, First Edition, 2007.
3.CharlesH.Roth, Jr. and Larry L. Kinney, “Fundamentals of Logic Design”, CL Engineering, 7th Edition, 2013.
4.WilliamH.Gothmann, “Digital electronics: an introduction to theory and practice”,Prentice-Hall,2006 .
5.http://www.b-u.ac.in/sde_book/digi_com.pdf

COURSE OUTCOMES (COs)	
CO1	Perform arithmetic operations in any number system.
CO2	Understand the hierarchical memory system and data transfer with in a digital computer.
CO3	Use Boolean simplification techniques to design a combinational hardware circuit.
CO4	Understand the concept of number system.
CO5	Learn the various gates like AND, OR, NOT, XOR.
CO6	Learn the concept of synchronous and asynchronous sequential circuits.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H	H	H	M	M	M	H	H	M		M
	CO2	M	H	M	H						M	
	CO3	M		H	H	H	L	H	M			M
	CO4	H	M							M	M	H
	CO5	H		H	M		H	M	M			M
	CO6	M	H	M		M				L	L	
3	Category	Professional Core (PC)										
4	Approval	47th Academic Council, July 2018										

U18PCMT306	**ELECTRICAL MACHINES & DRIVES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics-II, Basic electrical engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of various types of DC and AC machines with its drives				

UNIT I CIRCUITS AND TRANSFORMERS 6

D.C. Voltage, current, power-Ohms law-series, parallel circuits – Kirchoff's laws – mesh analysis – A.C. voltage – sinusoidal waves, phasor representation – power factor – complex power - basic idea of transformers – simple problems.

UNIT II ELECTRICAL MOTORS 12

Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motors, universal motors, stepper motors and reluctance motor.

UNIT III SPEED CONTROL AND STARTING 9

Speed control of D.C. motors – three phase induction motors – starting methods of D.C. motor and three phase induction motor – electrical braking – simple problems.

UNIT IV ELECTRICAL DRIVES 9

Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems.

UNIT V SOLID STATE DRIVES (QUALITATIVE TREATMENT ONLY) 9

Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators.

TEXTBOOKS

1. S.K. Bhattacharya "Electrical Machines" Tata McGraw-Hill Pvt. Company Ltd., 3rd edition, 2008.
2. ShaahinFilizadeh,"Electric Machines and Drives: Principles, Control, Modeling, and Simulation",CRC Press,2013.

REFERENCE

1. I.J. Nagrath, T.P. Kothari., "Basic Electrical Engineering", McGraw-Hill Publishing company Ltd., Second edition, 2002.
2. Ned Mohan,"Electrical Machines and Drives" First course ,Wiley Publication,2012.
3. Jan A. Melkebeek,"Electrical Machines and Drives: Fundamentals and Advanced Modelling,Springer,2018.
4. Dieter Gerling,"Electrical Machines: Mathematical Fundamentals of Machine Topologies",springer,2014.
5. G.K. Dubey "Fundamental Electrical Drives", Narosa Publications, Second edition, 2002.

COURSE OUTCOMES (COs)	
CO1	Able to get the basic knowledge about the Electric and Magnetic circuits, AC fundamentals and transformers.
CO2	Able to get the knowledge about the construction and working of DC, AC and Special machines.
CO3	Able to get the knowledge about the starting and speed control AC and DC machines.
CO4	Able to get the basic concepts of Drives, Electric drives, types and factors influencing

	the choice of electrical drives												
CO5	To understand the working principle of DC &AC motors drives and their characteristics and its braking methods												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L					H
	CO2		H	L			L		M	L	M	M	H
	CO3		H									L	
	CO4			L					M	L			
	CO5	M	L			H	L	L					M
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT3L1	**ELECTRONIC CIRCUITS AND DEVICES – LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Engg Mathematics-I, Basic electronics Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To design an working of basic electronics circuits like power supply, oscillator, amplifier etc				

LIST OF EXPERIMENTS

1. Characteristics of PN junction and Zener diode.
2. Input and Output characteristics of CB ,CE configuration.
3. Drain and Transfer characteristics of JFET.
4. Characteristics of SCR ,Triac, Diac& UJT.
5. Half wave Rectifier & Full Wave rectifier.
6. Series voltage regulator.
7. Design of RC coupled amplifier &FET Amplifier.
8. Hartley Oscillator &Colpitt's oscillator.
9. Astable, Monostable ,BistableMultivibrator.
10. Clippers & clampers.

LIST OF EQUIPMENTS AND COMPONENTS

1. Variable Power Supply (0-30V) - 6
2. CRO - 4
3. Digital Multimeter - 6
4. Function Generator - 4
5. DC Ammeter - 4

Consumables

6. Transformers
7. Resistors ¼ Watt Assorted
8. Capacitors
9. Inductors
10. Diodes and Zener diodes
11. Bread Boards
12. ICS – 555, 741, LM 328, LM 324
13. BC107, BC147,BC 108, BC 148, BC547, BC 548, SL 100, SK100 or Equivalent transistors
14. Wires

COURSE OUTCOMES (COs)	
CO1	To study the characteristics of diodes like PN diode and zener diode
CO2	To study the I/O characteristics of transistors in various configurations
CO3	To study the various characteristics of power transistors
CO4	To study the various characteristics of special transistors
CO5	To design and test rectifier circuits and series voltage regulators

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M		H						L		L	H
	CO2	M				H	L	M	M				
	CO3			H		H			M	L		L	H
	CO4						L	M					
	CO5	M		H		H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT3L2	**ELECTRICAL MACHINES &DRIVES LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Engg Mathematics-I, Basic Electrical Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The ability to conduct testing and experimental procedures on different types of electrical machines.				

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.

3. Swinburne's test
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three-phase induction motor.
6. Load test on single phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors
9. Performance characteristics of Stepper motors.
10. Performance characteristics of single phase transformer.

LIST OF EQUIPMENT

(For a batch of 30 students)

S.No	**Equipments**	**Qty**
1.	Shunt motor 5HP	3
2.	Single phase Induction Motor 2HP	2
3.	Three phase induction Motor 5HP	2
4.	Single phase transformer 2KVA	1
5.	Three phase quto transformer	2
6.	Single phase auto transformer	2
7.	3 point starter	3
8.	DPST, TPST	Each 2
9.	DC source 300v, 100A	1
10.	Ammeter (0-5A), (0-10A) MC	Each 2
11.	Ammeter (0-5A), (0-10A) MI	Each 2
12.	Voltmeter (0-300V) MC	3
13.	Voltmeter (0-150V), (0-300V), (0-600V) MI	Each 2
14.	Wattmeter 150/300V, 5/10A UPF	2
15.	Wattmeter 300/600V, 5/10A UPF	2
16.	Wattmeter 150/300V, 5/10A LPF	2
17.	Wattmeter 300/600V, 5/10A LPF	2
18.	Stepper motor 5Kg	1
19.	Synchronous motor 5KW	1
20.	Rheostat 360 ohm/1.2A	3
21.	Rheostat 50 ohm/5A	3
22.	Tachometer	5

COURSE OUTCOMES (COs)	
CO1	Understand the concept of efficiency and the short circuit impedance of a three-phase transformer from no-load test, winding resistance, short circuit test, and load test.
CO2	Understand the effect of unbalanced loading on a three-phase transformer with different connections, and the effects and limitations of each connection..
CO3	Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors.
CO4	Experimentally obtain the load characteristics of various dc motors and generators

CO5		Experimentally obtain the load characteristics, starting current and starting torque of a squirrel-cage induction motor and to derive circuit parameters from no-load and blocked-rotor tests											
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H				M		H	H		H	
	CO2	H		M	H	M	H	M					H
	CO3							M	M	H			
	CO4		M	H	M			H				H	M
	CO5					H	M			M			
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

18MCAB305	**CULTURAL- LEARNING AN ART FORM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Learning an Art Form

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the

institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306	**CULTURAL- INTANGIBLE CULTURAL HERITAGEO(Festivals, Food ways, Local Games)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by –				

Intangible Cultural Heritage (Festivals, Food ways, Local Games)

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm

to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

To study and document the prevalent social practices and beliefs regarding traditional foods;

To study and document the feasts on religious and social occasions of different communities;

To identify and document the food items consumed by different communities and determine their nutritional values;

To conduct chemical analysis of food ingredients;

To identify and document the kitchen generated health ingredients used by different communities;

To find out the uses of leftover food stuff of different communities;

To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and

To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

SEMESTER -IV

U18BSMA401	**Numerical Methods (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical)**	**L**	**T**	**P**	**C**
	Total Contact Periods: 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT 1 SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS **9 Hrs**

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT 2 INTERPOLATION **9 Hrs**

Finite differences - Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT 3 NUMERICAL DIFFERNTIATION AND INTEGRATION **9 Hrs**

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT 4 INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION **9 Hrs**

Single step methods- Taylor series, Euler and modified Euler methods, Runge Kutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's - Bash forth predictor and corrector methods.

UNIT 5 BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATION **9 Hrs**

Finite difference - solution of 2^{nd} order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for one dimensional wave equation.

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5^{th} edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42^{nd} Edition, 2016.

3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005 .

REFERENCE BOOKS

1. Curtis F. Gerald. "Applied Numerical Analysis" 7th Edn. Pearson Education,
2. Dennis G. Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jones & Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K. Gunavathi - Numerical methods, S.Chand & Company, 2nd Edition 2010.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO2	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO3	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Be exposed Taylor's series and Runge-Kutta methods to solve initial value problems of ODE
CO5	Student will be able to solve two dimensional Laplace, Poisson equations and one dimensional heat and wave equations of PDE.

CO/PO Mapping **S – Strong, M – Medium, W – Weak**												
COs	**Students Outcomes (SOs)**											
	SO1	**SO2**	**SO3**	**SO4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**	**SO12**
CO1	S	M			S		W	M	W	W	M	S
CO2	S	W		M	S	W		M			W	M
CO3	S		M		S		W		W		W	M
CO4	S	M			M				W			
CO5	S	M	S	M	M	W			M	W	M	
Category	Basic Science (BS)											
Approval	47th Academic Council, July 2018											

U18PCMT402	**DYNAMICS OF MACHINES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – Engineering Mechanics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of dynamics of machines. To acquaint the student with various techniques involved in dynamics and various new technology in dynamics of machines.				

UNIT I FORCE ANALYSIS OF MECHANISMS 12

Static, Inertia and combined force analysis- Graphical and analytical method- Slider crank mechanism and four bar mechanism. Turning moment diagram and flywheel-Applications in engine, Punching presses.

UNIT II BALANCING 12

Static and dynamic balancing-Balancing of rotating masses- Balancing of several masses in different planes. Primary and secondary unbalanced forces of reciprocating parts-Balancing of in line engines- Firing order- Balancing of 'V' and 'W' engines.

UNIT III FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM 12

Fundamentals of vibrations-Undamped free vibrations of single d.o.f systems–Derivation & solution of differential equation-Torsional Vibrations-single rotor- Equivalent stiffness of spring combinations-Bifilar, Trifilar suspensions-Compound pendulum-Types of damping-Damped free vibrations of single d.o.f-over, critical, under damped- Damping coefficient - Critical damping coefficient-Logarithmic decrement

UNIT IV FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS 12

Forced vibrations with-Constant harmonic excitation-Rotating & Reciprocating unbalance-Excitation of the support-Energy dissipated by damping-Forced vibrations with coulomb, viscous damping-Vibration Isolation and Transmissibility- Vibration Absorbers

UNIT V CRITICAL SPEEDS AND SHAFTS WITH ROTORS 12

Lateral vibration of beams - Whirling speed of shaft - Shafts with two & three rotors-Geared system. Dunkerly's method for different types of beams & shaft with several loads.

TEXTBOOKS

1. S.S.Rattan-Theory of Machines- Tata McGraw Hill(4th Edition), 2014.
2. Singh.V.P. Mechanical Vibrations-Dhanpatrai & co (p) Ltd(4th edition), 2010

REFERENCES

1. Rao.J.S. and Dukkipatti, Mechanism and Machines Theory, 2nd Edition-Wiley Eastern Ltd, 2007.
2. Balaguru.S. Dynamics of Machinery, Sci Tech Publications (India) Pvt Ltd, 2011.
3. Grover.G.K. Mechanical Vibrations- Nemchand & Bros.(8th Edition), 2012
4. https://books.google.co.in/books?isbn=1259051285.

COURSE OUTCOMES (COs)	
CO1	To learn the concept about force analysis for mechanism.
CO2	To understand the various methods of balancing in different situation.
CO3	To learn the Concept about free vibration of single degree of freedom.
CO4	To study the Concept about forced vibration of single degree of freedom.
CO5	To learn the lateral vibration of beam
CO6	To learn the concept about critical speed of rotating shaft
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M			M			L				
	CO2	H											H
	CO3		M						L				
	CO4		M			M							M
	CO5	H	M	M					L				
	CO6	H				M							H
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT403	**MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To Understand the various concept of manufacturing technology to produce new product and to acquaint the student with various manufacturing technologies used in production engineering.				

UNIT I FOUNDRY TECHNOLOGY 9

Pattern and Core making – Molding sand – Melting furnaces Cupola and Induction furnaces – Special casting processes – Shell, Investment, Die casting – Defects in casting.

UNIT II FORMING– PROCESSES 9

Hot and Cold Working

Rolling: Introduction – Rolling Mills – Rolling Operations – Production of Seamless Tubing and Pipe.

Forging : Introduction – Related Forging Operations – Drop forging

Extrusion and Drawing: Extrusion Practice – Hot, Cold, Impact and Hydrostatic extrusion. Drawing Process – Defects and Residual Stresses – Drawing Equipment. Sheet metal operations – Blanking, Punching and Piercing.

UNIT III MATERIAL – REMOVAL PROCESSES 9

Lathes and Lathe Operations, Drilling and Drilling Machines, Reaming and Reamers, Tapping and Taps – Tool nomenclature, cutting speed, feed, machining Time calculations.

UNIT IV MATERIAL – REMOVAL PROCESSES 9

Milling Machines and Operations, Planning and Shaping, Broaching, Gear Hobbing and Shaping.

Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Powder coating.

UNIT V PRINCIPLES & APPLICATIONS OF JOINING PROCESSES 9

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding,

Resistance Welding and Explosive Welding. Principles and applications of Brazing and Soldering.

TEXTBOOKS

1. KALPAKJIAN, S., "Manufacturing Engineering and Technology", Pearson education India, 7th edition, 2015 (**SBN-13:** 978-9814514828)

REFERENCES

1. Hajra Choudhury, S.K., and Haqjra Choudhury, A.K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2010.
2. Paul Degarma E, Black J.T. and Ronald A. Kosher, Eighth edition, Materials and Processes in Manufacturing Prentice – Hall of India, 2011.
3. Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd., 2007.
4. https://books.google.co.in/books?isbn=8185099154, 1118163737, 8121911141.

COURSE OUTCOMES (COs)													
CO1	To learn different types of foundry technology												
CO2	To understand the different types of forming– processes												
CO3	To learn the material removal processes and machine (i.e. lathe)												
CO4	To learn the material removal processes and machine **(**i.e. milling**)**												
CO5	To learn the principles & applications of joining processes.												
CO6	To Understand Principles and applications of Brazing and Soldering.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H							H
	CO2					H							
	CO3		M		H	H							H
	CO4				M	H							
	CO5					H							H
	CO6	M			M	H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT404	**POWER ELECTRONICS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –Fundamentals of Electronics Circuits and Devices				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To get an overview of different types of power semi-conductor devices and to understand parameters of controlled rectifiers, inverters, AC voltage controller and cycloconverters.				

UNIT I POWER SEMI CONDUCTOR DEVICES 9

Principle of operation – Characteristics of power diodes, SCR, TRIAC, GTO, Power BJT, Power MOSFET and IGBT – Thyristor protection circuits.

UNIT II PHASE CONTROLLED CONVERTERS 9

Single phase full converters, 3 phase half converter and 3 phase full converter – inverter operation – input power factor – effect of source inductance – Thyristor triggering circuits.

UNIT III DC TO DC CHOPPERS 9

DC Chopper – Principle of operation – step up and step down chopper – Forced commutation – different techniques – voltage, current and load – commutated choppers – step up and step down chopper.

UNIT IV INVERTERS 9

Voltage source inverters – series, parallel and bridge inverters – PWM inverters – current source inverters.

UNIT V AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS 9

Single phase AC voltage controller – multistage sequence control – step up and step down cycloconverters – three phase to single phase and three phase cycloconverters.

TEXTBOOKS

1. Rashid, M.H., "Power Electronics – Circuits Devices and Application" Prentice Hall International, New Delhi, 3rd Edition, 2011.

REFERENCES

1. Lander, W., "Power Electronics" McGraw-Hill and Company, 4th Edition, 2009.
2. Singh, M.D., Khanchandani, K.B., "Power Electronics", Tata McGraw-Hill, 2008.
3. Dubey, G.K., Doradia, S.R., Joshi, A. and Singh, R.M., "Thyristorised Power Controllers", Wiley Eastern Limited, 2005.
4. Joseph Vithayathil, "Power Electronics – Principle and Applications", and Robbins, "Power Electronics", McGraw-Hill Inc, New York, 2006.
5. Mohan Undeland and Robbins, "Power Electronics", John Wilry and Sons, New York, 2011.

COURSE OUTCOMES (COs)	
CO1	To learn different types of power semi-conductor devices and their characteristics.
CO2	To understand the operation, characteristics and performance parameters of controlled rectifiers
CO3	To study the operation, switching techniques and basic topologies of DC-DC converters.
CO4	To learn the operation of different types of inverters like VSI, CSI, PWM Inverters, Series inverter and parallel inverter.
CO5	To study the operation of AC voltage controller and cycloconverters.
CO6	To study the Principle of operation step up and step down chopper

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H	H	M	H	L			H	H			H
	CO2	H	H	H	H	H			H	H			H
	CO3	H	H	H	H	H			H	H			H
	CO4	H	H	L	H	M			H	H			M
	CO5	M	M	H	H	H			H	H			M
	CO6	H	H	H	H	H			H	H			H
3	Category	Professional Core (PC)											
4	Approval	47th Meeting of Academic Council, May, 2018											

U18PCMT405	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – Engg Mathematics-I, Engg Mathematics -II, Basic Electrical & Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To provide an introduction to the analysis of linear control systems. This will permit to exploit time domain and frequency domain tools.				

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – open and closed loop systems Examples – Mathematical model, Translational & Rotational systems – transfer function – block diagram reduction techniques – signal flow graph.

UNIT II TIME RESPONSE 9

Time response – time domain specifications – types of test inputs – I and II order system response – error coefficients – generalized error series – steady state error – P, PI, PD, PID Controller characteristics.

UNIT III FREQUENCY RESPONSE ANALYSIS AND DESIGN 9

Performance specifications – correlation to time domain specifications – Bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

UNIT IV STABILITY OF CONTROL SYSTEMS 9

Characteristic equation – location of roots in s-plane for stability – Routh Hurwitz criterion – root locus techniques – construction – gain margin and phase margin – Nyquist stability criterion.

UNIT V COMPENSATION DESIGN 9

Design concepts – realization of basis compensation – cascade compensation in time domain and frequency domain (simple MATLAB applications to analysis and compensators design problems.)

TEXTBOOKS:

1. M. Gopal, "*Control Systems: Principles and Design*", 3rd Edition, McGraw, Hill, 2014.

REFERENCE:

1. Katsuhiko Ogata, "Modern Control Engineering" 5th Edition, Prentice Hall of India Private Ltd., New Delhi, 2012.
2. ChesmondC.J. "Basic Control System Technology", Viva Low Priced Student Edition, 2012.
3. Datton K., Banaclough W. and Thompson S., "The Art of Control Engineering", Addison Wesley 2005.
4. R.C. Dorf and R.H. Bishop, "Modern Control Systems", 12th Edition, Prentice, Hall, 2010.
5. Leonard N.E. and William Levine, "Using MATLAB to Analyze and Design Control Systems", Addision Wesley (2nd edition), 2006.
6. http//www.controlsys.com

COURSE OUTCOMES (COs)													
CO1	To learn the concept of System and their representation.												
CO2	To understand the Concept of time response analysis.												
CO3	To learn the Concept of frequency response analysis.												
CO4	To study the various methods for stability of the systems.												
CO5	To learn the various types of compensation techniques.												
CO6	To Understand Transient response analysis, Root locus, Bode diagrams, Nyquist plots with MATLAB												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M							
	CO2	H	H	L		M							
	CO3	H	H		L	M							
	CO4	H	H			M							
	CO5	H	H			M							
	CO6	H	H			M							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT406	**TRANSDUCER ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Measurement and instrumentation				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To improve the ability to model and analyze transducers.				

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Calibration methods – Static calibration – Classification of errors :- Limiting error and probable error – Error analysis :– Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range -

Dynamic characteristics: – Mathematical model of transducer – Zero, I and II order transducers – Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezoresistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Induction potentiometer – Variable reluctance transducers – EI pick up – Principle of operation, construction details, characteristics and applications of LVDT –Capacitive transducer and types – Capacitor microphone – Frequency response.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor- Digital transducers – Smart sensors – Fibre optic sensors- Film sensors-Introduction to MEMS and Nano sensors.

TEXT BOOKS

1. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.

REFERENCES

1. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
2. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. S.Vijayachitra,"Transducer Engineering",PHI Learning Private Limited,2016
4. Clarence W.de Silva,"Sensors and Actuators:Engineering System Instrumentation,2nd Edition,CRC Press,2015
5. BelaG.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.
7. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
8. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

COURSE OUTCOMES (COs)	
CO1	To understand how physical quantities are measured
CO2	To learn the basics of calculating errors.
CO3	To have an adequate knowledge in resistance, transducers.
CO4	To develop the knowledge of inductance and capacitance transducers.
CO5	To study the characteristics of Transducers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M							
	CO2	H	H	L		M							
	CO3	H	H		L	M							

	CO4	H	H			M							
	CO5	H	H			M							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18MCTH 401	CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours - 45	2	0	0	0
	Prerequisite – Professional Courses				
	Course Coordinator Name & Department:- Department of Management studies				

OBJECTIVES

To know about Indian constitution. To know about central and state government functionalities in India. To know about Indian society.

COURSE OUTCOMES (COs)

CO1	To understand the historical background and fundamental rights
CO2	To understand the structure and functions of governments
CO3	To understand the Indian social structure
CO4	To gain knowledge in Indian federal system
CO5	To gain knowledge Indian social structure
CO6	To gain knowledge the right of women, children and SC&ST

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	1		3									
	CO2					3			2	1			
	CO3	1					3			1			
	CO4							2		1			
	CO5	1					2		2				
	CO6												

	Category	Mandatory Course
4	Approval	47th Academic Council, July 2018

UNIT I **9**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II **9**

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III **9**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV **9**

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V **9**

Society : Nature, Meaning and definition; Indian Social Structure; Castle, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TEXT BOOKS:

1. Agarwal R.C., " (1997) Indian Political System ", S.Chand and Company, New Delhi.
2. Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

REFERENCES:

1. Gahai U.R, "(1998) Indian Political System ", New Academic Publishing House, Jalaendhar.
2. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
3. Sharma K.L, " (1997) Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi.

4. Sharma R.N., "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.
5. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
6. Yogendra Singh, "(1997) Social Stratification and Charge in India ", Manohar, New Delhi
7. www.cgsird.gov.in/**constitution**

U18PCMT4L1	MACHINE DYNAMICS LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To learn about Governors /CAM, Motorized Gyroscope and Vibrating system Spring mass.				

LIST OF EXPERIMENTS

1. Governors - Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorized Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficient for multi degree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of tensional frequencies for compound pendulum and flywheel -system with lumped Moment of inertia
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

LIST OF EQUIPMENT (for a batch of 30 students)

1. Cam analyzer. - 1 No
2. Motorized gyroscope. - 1 No.
3. Governor apparatus - watt, porter, proell and hartnell governors. - 1 No.
4. Whirling of shaft apparatus. - 1 No.
5. Dynamic balancing machine. - 1 No.
6. Static and dynamic balancing machine. - 1 No.
7. Vibration test facilities apparatus - 1 No.

COURSE OUTCOMES (COs)	
CO1	To learn&Pratices about Governors /CAM
CO2	To Learn &Practice The Experiments Like Gyroscope

CO3	To Learn &Practice The Experiments Like Vibrating System Mass.	
CO4	To Learn &Practice The Experiments Like Determination of Moment of inertia	
CO5	To know the concepts of electrical actuator	

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1			M			H			H	H	
	CO2			M			H			H	H	
	CO3			M			H			H	H	
	CO4			M			H			H	H	
	CO5											
3	Category	Professional Core(PC)										
4	Approval	47 th Meeting of Academic Council, July, 2018										

U18PCMT4L2	**SENSOR AND INSTRUMENTATION LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Electronic Circuits and Devices - Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of various instrument involved in industry with various practical concepts in instrumentation and control and to introduce the various advanced technology in controlling technique.				

LIST OF EXPERIMENTS

1. PRESSURE MEASUREMENT AND CONTROL
   Pressure measuring devices – Pressure and vacuum gauge calibration.
2. TEMPERATURE MEASUREMENT AND CONTROL
   Temperature measuring devices like platinum resistance thermometer, thermocouple etc
3. SPEED MEASUREMENT AND CONTROL
   Studying the devices and characters and measuring the speed using tachometer, stroboscope, etc.
4. FORCE MEASUREMENT
   Force measuring devices, load cells and proving rings.
5. TORQUE MEASUREMENT
   Torque measurement –using torque measuring devices.
6. POSITION MEASUREMENT
   Position and velocity measurement using encoders,linear scales
7. STRAIN MEASUREMENT
   Study and use of strain – strain gauge indicator.
8. DISPLACEMENT MEASUREMENT
   LVDT-Displacement and velocity measurement using encoders.
9. Analog to Digital Converters

10. Study on the application of data acquisition system for industrial purposes.

COURSE OUTCOMES (COs)	
CO1	To learn the practical experiments about pressure measurement and control
CO2	To understand the practical experiments about force and torque measurement
CO3	To learn the practical experiments about temperature measurement and control
CO4	To learn the practical experiments about speed measurement and control
CO5	To learn the practical experiments about application of data acquisition system for industrial purposes

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M	H	M	H							
	CO2			H	M	H							
	CO3	L			M	H							
	CO4		M	H	M	H							
	CO5	L	M		M	H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18EEMT4L3	**TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours -15	0	0	2	1
	Prerequisite – Basic English knowledge				
	Course Designed by –Department of Mechatronics				
OBJECTIVES	To improve the communication skills of the students				

During the Seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also.
Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

COURSE OUTCOMES(CO_S)	
CO	To improve the communication skills of the students

	LITERATURE & MEDIA – LITERATURE ,CINEMA& MEDIA	**L**	**T**	**P**	**C**
U18MCAB407					

	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description

Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not just the literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408	**LITERATURE & MEDIA – GROUP READING OF CLASSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0

	Prerequisite –
	Course Designed by –

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

SEMESTER-V

U18PCMT501	MICRO CONTROLLER &PLC	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the Architecture of 8051 and addressing modes. To get the knowledge about 8051 micro controller design, testing design and the applications of the PLC.				

UNIT I INTRODUCTION TO MICROCONTROLLER 12

8051 Architecture: Microcontroller Hardware – I/O Pins, Ports – External memory – Counters and Timers – Serial data I/O – Interrupts –Instruction set of 8051-Addressing modes- Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, interrupts.

UNIT II 8051 MICROCONTROLLER DESIGN 12

8051 Microcontroller Design: 8051 Microcontroller Specification 8051 – Microcontroller System Design – Testing the Design, Timing Subroutines, Look up Tables – Serial Data Transmission.

UNIT III INTERFACING AND APPLICATIONS 12 Stepper motor control-Keyboard interfacing-Alpha-Numeric display interfacing Devices –Analog to digital converter interfacing-Digital to analog converter interfacing- Interfacing of Electronic weighing bridge.

UNIT IV INTRODUCTION TO PLC 12 Programmable Logic Controllers: Introduction – Parts of PLC – Principles of operation – PLC sizes – PLC hardware components — PLC programming Simple instructions – Connecting PLC to computer interlocks and alarms -Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

UNIT V APPLICATIONS OF PLC 12

Timer instructions ON DELAY, OFF DELAY and RETENTIVE Timers, UP COUNTER, DOWN COUNTER and UP DOWN COUNTERS, control instructions – Data manipulating instructions, match instructions; Applications of PLC –case study of Tank level control system - Automatic lubrication of supplier Conveyor belt - Automatic control of warehouse door.

TEXTBOOKS:

1. Kennath J. Ayala.The 8051 Microcontroller Architecture, Programming and Applications, Penram International Publishing (India), 3rd Edition, Mumbai.

1. Microcontroller-Internals, Instructions, Programming & Interfacing by Subrata Ghoshal, Pearson.
2. David Calcutt, Frederick Cowan, and Hassan Parchizadeh," 8051 Microcontroller: An ApplicationsBased Introduction ".
3. FrankD.Petruzella."Programmable Logic Controllers", McGraw–HillBook, 1989.3rd Ed

REFERENCES

1. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, 2nd Edition, New Delhi, 1997.
2. Embedded Controller Hand book, Intel Corporation, USA.
3. Microcontroller Hand Book, INTEL, 1984.

COURSE OUTCOMES (COs)	
CO1	To learn the Architecture of 8051 microcontroller.
CO2	To understand the 8051 micro controller design and testing design.
CO3	To learn the 8051 micro controller applications.
CO4	To learn the programmable logic controllers.
CO5	To learn the applications of the PLC.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				L	H							
	CO2	M			M	H							
	CO3				L	H		M					
	CO4				L	H		M					
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

	CNC TECHNOLOGY	**L**	**T**	**P**	**C**

U18PCMT502	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Engineering Mechanics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the CNC technology for to production of product sand to learn the student with various CNC technology used in production engineering. To introduce the industrial current trends in the production technology				

UNIT I FUNDAMENTALS OF CNC MACHINES 9

Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines.

UNIT II CONSTRUCTIONAL FEATURES OF CNC MACHINES AND RETROFITTING 10

Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors.Retrofitting of Conventional Machine Tools: Modification to be carried out on conventional machines for retrofitting.

UNIT III CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING 10

Description of a simple CNC control system.Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices.

UNIT IV CNC PART PROGRAMMING 9

Part Program Terminology-G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

UNIT V ECONOMICS AND MAINTENANCE 7

Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements.

TEXTBOOKS

1.YoremKoren, “Computer Control of Manufacturing Systems”, McGraw Hill, 2005.

REFERENCE

1. P Radhakrishnan., Computer Numerical Control Machines and Computer Aided Manufacture , New Age International Publishers, 2018.

2. GROOVER, M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall (4th Edition), 2015.
3. G.E.THYER, Computer Numerical Control of Machine Tools (2nd Edition),Butterworth-Heinemann Publisher, 2014.
4. MIKE MATTSON, "CNC Programming Cengage Learning, 2009.

COURSE OUTCOMES (COs)	
CO1	To introduce the fundamentals of CNC Technology.
CO2	To understand the constructional features and retrofitting of CNC machines.
CO3	To learn the types of controls system, various feedback devices and tooling.
CO4	To practice writing programs using G codes and M Codes.
CO5	To learn the economics and maintenance of CNC installation.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H						M	
	CO2					H			M	H		L	
	CO3		M		H	H							
	CO4				M	H			M				
	CO5					H				H		L	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18HSBA501	**ORGANIZATIONAL BEHAVIOUR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Management Studies				
OBJECTIVES	To provide an overview of theories and practices in organizational behavior in individual, group and organizational level				

Module I Focus and Purpose 5 Hours

Definition, need and importance of organizational behavior – Nature and scope – Frame work – Organizational behavior models.

Module II Individual Behavior 12 Hours

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification. Misbehaviour – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception Impression Management. Motivation – Importance – Types – Effects on work behavior.

Module III Group behavior 10 Hours

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

Module IV Leadership and Power 8 Hours

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

Module V Dynamics of Organizational Behaviour 10 Hours

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives –. Organizational effectiveness Developing Gender sensitive workplace

REFERENCES

1. Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.
2. Nelson, Quick, Khandelwal. ORGB – An innovative approach to learning and teaching. Cengage learning. 2nd edition. 2012
3. Ivancevich, Konopaske&Maheson, Oranisational Behaviour& Management, 7th edition, Tata McGraw Hill, 2008.
4. UdaiPareek, Understanding Organisational Behaviour, 3rd Edition, Oxford Higher Education, 2011. 5. Jerald Greenberg, Behaviour in Organization, PHI Learning. 10th edition.

COURSE OUTCOMES (COs)	
CO1	Understanding the concepts of Management. They will know the framework for managing individual and group performance.
CO2	Students will have a better understanding of human behavior in organization.
CO3	In-Department h Understanding about the concepts of Group Behavior
CO4	Understanding the Organization Theory & Approach.
CO5	Students will have a better understanding of organizational behavior

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H					H					H	
	CO2		H		M					H			
	CO3	M							M		H		
	CO4			M	H							H	
	CO5							M					
3	Category	Basic Science(BS)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18PCMT503	**INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Fundamentals of Electronic Devices and Circuits				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of Integrated Circuits and Various new technology in Integrated Circuits. To acquaint the student with various concepts used in integrated circuits				

UNIT I CHARACTERISTICS OF OPAMP & ITS FUNDAMENTALS 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of opamp - summer, differentiator and integrator, V/I &I/V converter.

UNIT II APPLICATIONS OF OPAMP 9

Sign Changer, Scale Changer, Phase Shift Circuits, Logarithmic amplifier, Precision rectifier, Instrumentation amplifier, Comparators, multivibrators, Schmitt trigger, waveform generators, clippers, clampers, peak detector, S/H circuit, First and Second order active filters, Low-pass, high-pass and band-pass Butterworth filters

UNIT III ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type – Single Slope type – Dual Slope type – A/D Converter using Voltage-to- Time Conversion – Over-sampling A/D Converters.

UNIT IV SPECIAL ICs & VOLTAGE REGULATORS 9

555 Timer circuit - Functional block, characteristics & applications; 566-voltage controlled oscillator circuit, OP-Amp Voltage regulator-Series, Shunt and switching regulator.

UNIT V ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell – Variable trans conductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

TEXT BOOKS

1. RamakantAGayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education/ PHI 2003.
2. Roy Choudhary.D, SheilBJani, "Linear Integrated Circuits", II edition, New Age, 2003.
3. Morris Mano.M, "Digital Logic and Computer Design" Published byDelhi Pearson,2009.
4. Robert FCoughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education, 4th edition, / PHI 2002.
5. https://zawequbipy.files.wordpress.com

REFERENCES

1. David A.Bell, "Op-amp & Linear ICs", Prentice Hall of India, 4th edition,2002.
2. Charles H.Roth, "Fundamentals Logic Design", Jaico Publishing, 6th edition, 2006.

Floyd, "Digital Fundamentals", 10th edition, Pearson Education, 2008

COURSE OUTCOMES (COs)	
CO1	To learn the characteristics of op-amp & its fundamentals.
CO2	To understand the various application of op-amp.
CO3	To learn the various types of digital to analog and analog to digital converters.
CO4	To learn the concept of Special IC's and Voltage regulator.
CO5	To learn the concept of phase logged loop and function generator.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	L			H							
	CO2	H	L			H		L					
	CO3	H	L			H							
	CO4	H	L			H							
	CO5	H	L			H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PCMT5L1	MICRO CONTROLLER &PLC LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the programming concepts in 8051 Microcontroller and interfacing of Electronics Devices to it .				

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Study of Microcontroller Kits.
2. 8051 / 8031 Programming Exercises.
3. Stepper Motor interface.
4. D.C. motor controller interface.
5. Study of interrupt structure of 8051.
6. Interfacing high power devices to microcomputer port lines, LED relays and LCD displays.
7. Linear actuation of hydraulic cylinder with counter and speed control.
8. Hydraulic rotation with timer and speed control.
9. Sequential operation of pneumatic cylinders.
10. Traffic light controller.
11. Speed control of DC motor using PLC.
12. Testing of Relays using PLC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Equipments	Qty
1	Regulated power supply	7
2	Pulse generator	1
3	Function generator	5
4	Cathode ray osilloscope	5
5	8051 MicroController Kit	5
6	stepper Motor	2
7	stepper motor interfacing board	2
8	PLC trainer kit and related software	2
9	Hudraulic cylinder	1
10	Pneumatic cylinder	1
11	LED/LCD interface units	1
12	SCR/Triac/Power MOSFET interface unit	1

COURSE OUTCOMES (COs)	
CO1	To learn the basic programming of 8051 microcontroller.
CO2	To understand the 8051 micro controller interface Programming Exercises.
CO3	To learn the 8051 micro controller applications.
CO4	To learn the ladder programming in PLC

CO5	To learn the sequential operation in pneumatic cylinders

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							
	CO2	M			M	H		M			L		
	CO3				M	H			H				
	CO4				M	H		M					
	CO5				M	H					L		
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18PCMT5L2	**CNC LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours -30	0	0	2	1
	Prerequisite – Basic Mechanical engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To teach part programming in the CNC machines and produce various shapes CNC machine.				

LIST OF EXPERIMENTS

1. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.
2. Programming and Simulation of machining using the following features.
   a. Linear and Circular interpolation
   b. Pocket milling, slotting, peck drilling and other fixed canned cycles.
3. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.

LIST OF EQUIPMENT (for a batch of 30 students)

1. CNC Lathe with Fanuc controller - 1 No.
2. CNC Milling Machine with Fanuc controller- 1 No.
3. Master CAM software - 15 Licenses
4. Computer nodes - 15 Nos

COURSE OUTCOMES (COs)	
CO1	To explain the concept of metrology and measurement and various terms used in the metrology
CO2	To practices on programming and simulation of machining
CO3	To practices on Linear and Circular interpolation

CO4	To practices on Pocket milling, slotting, peck drilling and other fixed canned cycles
CO5	

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H	M								
	CO2			H	M								
	CO3			H	M	L							
	CO4			H	M								
	CO5												
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18MCAB509	**SELF DEVELOPMENT –SPRIRITUAL, MINDFULNESS & MEDITATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**0**	**0**	**2**	**0**
	Prerequisite – Nil				
	Course Designed by – AICTE				

Spiritual, Mindfulness and Meditation

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness.

The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta - cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions: multiple 10-day sessions may be organized over a semester.

U18MCAB510	SELF DEVELOPMENT – RELIGION AND INTER - FAITH	L	T	P	C
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under ‘book reading’.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

SEMESTER-VI

U18BSMA601	**Operations Research For Engineers (common to B.Tech - Mech, Mechatronics & Automobile)**	**L**	**T**	**P**	**C**
	Total Contact periods: 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics I & II and statistics				
	Course Designed by Department of Mathematics				
OBJECTIVES	To provide the student with the concept and an understanding of basic concepts in Linear Programming techniques, Duality Principles, Transportation and Assignment problems, Inventory models, PERT/CPM, Queuing and Replacement Models.				

UNIT I LINEAR PROGRAMMING
9 Hrs
Introduction to phases of an Operations Research study– Linear programming – Formulation of the Programming – Graphical method – Simplex method – Dual simplex method-Two phase method.

UNIT II TRANSPORTATION &ASSIGNMENT PROBLEMS
9 Hrs
Transportation models – Vogel's approximation method MODI method – Unbalanced transportation problem – Degeneracy in transportation models **-** Assignment problems – Hungarian method

UNIT III NETWORKS & REPLACEMENT MODELS
9 Hrs Networks – PERT and CPM – Network diagrams – Shortest route – Minimum spanning tree, Replacement models– Individual and Group replacement policy

UNIT IV INVENTORY MODELS 9 Hrs
Inventory models – Deterministic models – Production models – Economic Ordering Quantity Models – Quantity Discount Model – Multi Product Models – Inventory Control Models in practice.

UNIT V QUEUEING MODELS & RESOURCE SCHEDULING
9 Hrs
Queuing theory – Queuing system and structure – Kendal's notation– Poisson arrival and Exponential service time – Characteristic of queuing models – Single channel and multiple models. Resource scheduling – Sequencing of n- jobs through 2 machines and 3 machines.

TEXT BOOKS

1. Gupta and Hira D.S " Operations Research", S. Chand & Co, New Delhi, 2006
2. H. A. Taha, "Operations Research", Prentice Hall of India, 2002, Seventh Edition 2007.

REFERENCE BOOKS

1. Kanti Swarup, Gupta P.K., and Manmohan, "Operations Research", Sultan Chand & Sons 1997. Paneerselvam R., Operations research, Prentice-Hall of India, New Delhi, 2001.

2. T. Veerarajan, “Operations Research”, Published by Orient Black Swan, 2010.

COURSE OUTCOMES (COs)	
CO1	To Explain the basic concepts of optimization and to formulate and solve linear programming problems, Apply duality principle in day to day life style.
CO2	Apply the concepts of Transportation Problem and Assignment Problem, Participate in the class room discussion on Transportation algorithm.
CO3	Explain and demonstrate the basic concepts of PERT- CPM and their application, reproduce the network model.
CO4	Explain the basic concepts of optimization and to formulate and solve inventory problems.
CO5	Explain and apply the concepts of Queueing theory, sequencing problem and their application.

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Students Outcomes (SOs)**											
	SO 1	**SO2**	**SO 3**	**SO 4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**	**SO12**
CO1	S	S		S			M	M			W	
CO2	S	S	M		M					W		
CO3	S	S		M	S	W						
CO4	S	S	S	M	W				W			
CO5	S						W	M	S			
Category	Basic Science (BS)											
Approval	47th Academic Council, July 2018											

U18PCMT601	**APPLIED HYDRAULICS &PNEUMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To learn about the basic concepts of fluid power systems and various application and its circuits.				

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 12

Introduction: Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols.Basics of hydraulics – Applications of Pascal’s Law-Laminar and turbulent flow – Reynolds’s number-Darcy’s equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 12

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.
Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic. Cushioning mechanism, Construction of double acting cylinder, Rotary actuators. Fluid motors, Gear, Vane and Piston motors.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 12

Construction of Control Components: Directional control valve – 3/2 way valve – 4/2, 4/3 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.
Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit

UNIT IV PNEUMATIC SYSTEMS & COMPONENTS 12

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, Pneumatic actuators, Fluid Power Circuit Design-Speed control circuits, Synchronizing circuit, Electro Pneumatic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 12

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves,Fluidics – Introduction to fluidic devices, Simple circuits,PLC -Introduction, ladder diagrams, PLC applications in fluid power control, Fluid power circuits, failure and trouble shooting.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Pearson New International Edition, 2014

REFERENCES

1. Andrew Parr,”Hydraulics and Pneumatics ,A Technicians and Engineers Guide”,Elsevier Ltd,2011
2. Patrick J. Klette,”Fluid Power Systems”,American Technical Publishers, Incorporated, 2014
3. James R. Daines“Fluid Power: Hydraulics and Pneumatics”,G-WPublisher,2013
4. Peter Chapple”Principles of Hydraulic System Design”Momentum Press,2014
5. Ian C Turner,”Engineering Applications of Pneumatics and Hydraulics”Routledge,2011

COURSE OUTCOMES (COs)	
CO1	To introduce fundamentals of fluid power systems.
CO2	To learn various types and function of hydraulic components.
CO3	To design hydraulic circuits for simple practical applications.
CO4	To learn various types and function of pneumatic components.
CO5	To design pneumatic circuits for simple practical applications.

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M	H							H
	CO3				M	H		H		L			
	CO4				M	H		H					M
	CO5				M	H		H					
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT6L1	**CAD/CAM LAB for Mechatronics**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – CNC Lab, Finite element Analysis, Computer Aided Machine				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To impart knowledge about various software tools in CAD to design and model different products.				

LIST OF EXPERIMENTS

1. Solid modeling using Ideas / Pro Engineering / CATIA software of gives components / products such as (at least 3 components)
2. Analysis of engineering problems using FEA package (at least 3 problems)
3. Exercise in surface machining – Multi Axis Machining and software Development for manufacturing. (at least 3 jobs)
4. Computer assisted part programming using Master Computer Software for various internal and external curved surface machining.

LIST OF EQUIPMENT (FOR A BATCH OF 30 STUDENTS)

1. Any CAD software – 10 licenses
2. Any FEA software – 5 licenses
3. Any CAM software – 10 licenses

COURSE OUTCOMES (COs)	
CO1	To learn to design components like screw jack using Pro E
CO2	To learn to design components like Knuckle joint using Creo software

CO3	To learn to design products using Pro E &CATIA
CO4	To learn to analyze engineering problems using FEA package
CO5	To study about operations like drilling, boring in lathe using Precut software

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							H
	CO2	M			M	H							
	CO3				M	H		H		L			M
	CO4				M	H		H					
	CO5				M	H		H					
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT6L2	**HYDRAULICS &PNEUMATICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce design and testing hydraulic and pneumatic circuits. To learn the various control valves like flow, pressure, direction. To practice the simulation using given software.				

LIST OF EXPERIMENTS

1. **Design and testing of hydraulic circuits such as**
   - **ii)** Pressure control
   - **iii)** Flow control
   - **iv)** Direction control
   - **v)** Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer.
2. **Design and testing of pneumatic circuits such as**
   - **i)** Pressure control
   - **ii)** Flow control
   - **iii)** Direction control
   - **iv)** Circuits with logic controls
   - **v)** Circuits with timers
   - **vi)** Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
3. Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using **MATLAB/LABVIEW** software.
4. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.

LIST OF EQUIPMENT(for a Batch of 30 students)

S.No	**Equipments**	*Qty*
	Hydraulic Equipments	
1	Pressure relief valve	4
2	Pressure reducing valves	2
3	Flow control valves	2
4	Pressure switch	1
5	Limit switches	2
6	Linear actuator	1
7	Rotary actuator	1
8	Double solenoid actuated DCV	2
	Single solenoid actuated DCV	1
9	Hydraulic power pack with 2 pumps & 2 pressure relief valve	1
10	PLC	1

S.No	**Pneumatics Equipment**	**Qty**
1	Pneumatic trainer kit with FRL Unit, Single acting cylinder, push buttons.	1
2	Pneumatic trainer kit with FRL unit, Double acting cylinder, manually actuated DCV.	1
3	Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV.	1
4	Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid actuated DCV, DCV with sensors/ magnetic reed switches.	1
5	PLC with Interface card	1
6	LABVIEW Software& Automation studio software	

COURSE OUTCOMES (COs)	
CO1	To design and test the hydraulic circuits using various valves.
CO2	To design and test the pneumatics circuits using various valves.
CO3	To model and analysis of fluid power system using MATLAB/LABVIEW.
CO4	To simulate basic electric, hydraulic and pneumatic circuits.
CO5	To learn the practical experiments about pneumatics circuits.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M	H							
	CO3				M	H		H		L			
	CO4				M	H		H					
	CO5				M	H		H					

3	Category	Professional Core(PC)
4	Approval	47th Academic Council, July 2018

U18EEEMTS1	**SOFT SKILL LAB**		**L**	**T**	**P**	**C**
	Total Contact Hours –30		0	0	2	1
		Prerequisite – Communicative English				
		Course Designed by – Department of English				

OBJECTIVES	Develop their communicative competence in English with specific r eference to speaking and listening

COURSE OUTCOMES (COs)		
CO1		Develop their communicative competence in English with specific reference to speaking and listening
CO2		Enhance their ability to communicate effectively and efficiently in interviews.
CO3		Strengthen their prospects of success in competitive examinations.
CO4		Work with peer group in a smooth manner.
CO5		Develop inter personal and intra personal skills
CO6		Develop their communicative competence in English with specific reference to speaking and listening

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1												
	CO2							H					
	CO3												
	CO4				H								
	CO5				M								
	CO6												
	Category	Humanity Science (HS)											
4	Approval	47th Academic Council, July 2018											

UNIT I LISTENING AND SPEAKING SKILLS 6 hours

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio.

UNIT II READING AND WRITING SKILLS **6 hours**

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 6 hours

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

UNIT IV INTERVIEW SKILLS 6 hours

Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.

UNIT V SOFT SKILLS 6 hours

Motivation- emotional intelligence-Multiple intelligences-managing changes-time management-stress management-leadership traits-team work- career planning -intercultural communication- creative and critical thinking

To be totally learner-centric with minimum teacher intervention as the course revolves around practice.

1. Suitable audio/video samples from YouTube to be used for illustrative purposes.
2. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
3. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

REFERENCES:

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth , Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2013.
4. Evans, D, **Decision maker**, Cambridge University Press, 2010.

U18EEMT6I1	**SUMMER INERNSHIP**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	2	0
	Prerequisite –				
	Course Designed by –				

Industrial / Practical Training / Internship / Mini Project

The Industrial / Practical Training shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of Industrial / Practical training / internship / Summer Project, the student shall submit a brief report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department.

U18MCAB609	**SOCIAL SERVICES – SOCIAL AWARENESS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social awareness (Artisans-relates to engg., visit to hospitals, orphanages, policestation, courts, trauma centers, consumer forums)

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in *BanarasiSaari*, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of action.

U18MCAB610	**SOCIAL SERVICES – NSS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social Service (teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer**)**

SEMESTER-VII

U18PCMT701	**ROBOTICS &MACHINE VISION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Applied Hydraulics & Pneumatics, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the basic concepts and components of robotics .To learn the machine vision concepts based on Image Processing Techniques				

UNIT I ROBOTICS INTRODUCTION 9

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement.

Drives and control systems: Hydraulic systems, power supply – servo valve – sump – hydraulic motor – DC servo motors – stepper motors – operation.

Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link – Road Systems, Rotary to linear motion conversion, Rack and pinion drives, ball bearing screws, speed reducers, Harmonic drives.

UNIT II KINEMATICS OF ROBOT 10

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning.

UNIT III ROBOT END EFFECTORS 8

Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers – Robot end effector interface.

Sensors: Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers.

UNIT IV MACHINE VISION 9

Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations.

UNIT V FEATURE EXTRACTION 9

Geometry of curves – Curve approximation, Texture and texture analysis, Image resolution – Department h and volume, Color processing, Object recognition by features, Department h measurement, specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression, Real time Image processing, Application of Vision systems.

TEXT BOOK

1.Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012

REFERENCES

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.
3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

COURSE OUTCOMES (COs)	
CO1	To introduce the automation, robotics and its components
CO2	To explain the various methods of forward kinematics and reverse kinematics
CO3	To explain the various end effectors and sensors used in robot
CO4	To explain the machine vision technique
CO5	To explain the image processing technique and application of MV

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	H
	CO2	M		M	M	H	H				M		

	CO3		M		M	H	H		H	M			M
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	L
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT702	**DESIGN OF MECHATRONICS SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Control system, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various Mechatronics system design approaches and its case studies				

UNIT I INTRODUCTION 9

Introduction to Mechatronics system – Key elements – Mechatronics Design process – Types of Design – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Man machine interface, industrial design and ergonomics, safety.

UNIT II REAL TIME INTERFACING 9

Introduction - Elements of data acquisition and control - Overview of I/O process – Overframing.Selection of interface cards--DAQ card-single channel-multichannal-RS232/422/485communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch - Man machine interface

UNIT III CASE STUDIES ON DATA ACQUISITION AND CONTROL 10

Case studies on Data Acquisition: Introduction – Cantilever Beam Force Measurement system– Transducer calibration system for automotive applications – Strain gauge weighing system – Solenoid Force-Displacement calibration system.

Case studies on Data Acquisition and control: Introduction – pH control system – Dc-Icing Temperature Control system – Skip control of a CD player – Auto focus Camera, exposure control.

UNIT IV CASE STUDIES ON DESIGN OF MECHATRONIC PRODUCTS 9

Introduction–Fuzzy based Washing machine – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems. – Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V ADVANCED APPLICATIONS IN MECHATRONICS DESIGN 8

Introduction–Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics – Microsensors in Mechatronics

TEXT BOOKS:

1. Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, Thomson Learning Publishing Company, Vikas publishing house, 2001.

REFERENCES

1. Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
2. Brian Morriss, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995.
3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.

COURSE OUTCOMES (COs)	
CO1	To learn various types of Design processes.
CO2	To understand the concept of Real time interfacing.
CO3	To learn the various case studies on Data Acquisition and control**.**
CO4	To learn the various case studies on Mechatronics Products.
CO5	To learn the concept of advance application in Mechatronics.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H						L	
	CO2	M			M	H		M					
	CO3				M	H							
	CO4				M	H			M				
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, July, 2018											

U18PRMT7P1	**PROJECT STAGE -I**	**L**	**T**	**P**	**C**
	Total Contact Hours –18 periods per week	0	0	6	3
	Prerequisite – Professional Courses				
	Course Designed by – Department of Mechatronics.				

OBJECTIVES

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

COURSE OUTCOMES (COs)	
CO1	Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

CO2	This final report shall be typewritten form as specified in the guidelines.
CO3	The continuous assessment shall be made as prescribed in the regulations.
CO4	The student can able to design the components they required
CO5	Understand the different fabrication processes.
CO6	Will gain confidence to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H							M			L	
	CO2	H						H	M	H		L	
	CO3			H	H	H		H				L	
	CO4					M		H		M		L	
	CO5					M							
	CO6						M	H	M				

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	
									√	
4	Approval	47th Academic Council, July 2018								

U18PCMT7L1	**ROBOTICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite –Microcontroller & PLC Lab, Sensor & Instrumentation Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To impart knowledge on building robots and practice exercises on Robot				

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.

7. Robot programming exercises
(Point-to-point and continuous path programming)

LIST OF EQUIPMENT (for a batch of 30 students)

S.No	Name of the Equipment/components	No. of Items
1	Any one type of robot configuration with at least five degree of freedom.	1 set
2	Robot programming software inclusive of computer system.	10 licenses
3	Models of different types of end effectors drive systems Links and Joints.	5 each
4	Models of different configuration robots	5 each

COURSE OUTCOMES (COs)													
CO1	To understand different types of robots based on configuration and application												
CO2	To study of different type of links and joints used in robots												
CO3	To study about various end effectors used in robots												
CO4	To learn about the different types of drive system												
CO5	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT7L2	**SIMULATION AND PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite –Control System, Instrumentation and control Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	• To Write motion control programs • To design and Configure graphical screens for HMI (Human Machine				

	Interface) in LabVIEW and MATLAB.

LIST OF EXPERIMENTS

1. Programming exercises using loops and charts.
2. Programming exercises using clusters and graphs
3. Programming exercises using case and sequence structures, file input/output, string operations.
4. Creating virtual instrumentation for simple applications
5. Closed loop response of level control loop.
6. Closed loop response of flow control loop.
7. Closed loop response of temperature control loop.
8. Closed loop response of pressure control loop

LIST OF EQUIPMENT (for a batch of 60 students)

1. LAB VIEW Software – 10 licenses
2. MAT LAB Software - 10 licenses

COURSE OUTCOMES (COs)	
CO1	Use different sensors and actuators to control various industrial parameters: temperature, pressure, level and flow.
CO2	Write program for LabVIEW to interface and control various actuators.
CO3	Simulate and create virtual instruments.
CO4	Analyze the findings of experimental observations in both written and oral format.
CO5	Present the findings of experimental observations in both written and oral format.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

18MCAB713	**BEHAVIORAL AND INTERPERSONAL SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing differentaspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.

To help the students to understand the importance of non-verbal aspects of effective communication.

To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.

To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

Motivational lectures

Group Discussions/activities

Case Study

Games/Stimulation Exercises

Role-Playing
Mindfulness training.

U18MCAB714	**NATURE - NATURE CLUB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Nature club (bird watching, recognizing plants at institute/at home, recognizinglocal animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18PCMT801	**BIOMEDICAL INDTRUMENTATION FOR MECHATRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Instrumentation & Control, Electronic Devices and Circuits				
	Course Designed by – Dept of Mechatronics				

OBJECTIVES

To study about transducers. To study about medical support devices. To study about diagnostic instruments.

COURSE OUTCOMES (COs)

CO1	To learn basics about electrodes.
CO2	To learn about transducers in Medical Mechatronics.
CO3	To learn about amplifiers &recorders.
CO4	To learn about medical support devices.
CO5	To understand the biomedical diagnostic instrument.
CO6	To Understand the concept of Medical Instruments and circuits and we know its usage.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M				H				M
	CO3				M	H		M					
	CO4								H			M	M
	CO5				M	H							
	CO6			M									

3	Category	Humanities & Social Studies (HS)	Basic Sciences	Engg Sciences	Professional Core (PC)	Core Elective	Non-Major Elective (NE)	Open Elective (OE)	Project/Term Paper Seminar/ Internship

							√		
4	Approval	37th - 40th Meetings of Academic Council, May 2015 - Sept 2016							

UNIT 1 INTRODUCTION 9

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential

– electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

UNIT 1I TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT 1II SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply. Oscillagraphic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIV IV MEDICAL SUPPORT 10

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC

– defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIV V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION 8

Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis.

TEXT BOOKS :

1. Khandpur, R.S., ―Handbook of Biomedical Instrumentation‖, TMH, 1989.2nd Edition.
2. Arumugam M., ―Bio Medical Instrumentation‖, Anuradha agencies Pub., 2002.2nd Edition.

REFERENCES :

1. Geddes L.A., and Baker, L.E., ―Principles of Applied Bio-medical Instrumentation‖, 3rd Edition, John Wiley and Sons, 1995.
2. Cromwell, Weibell and Pfeiffer, ―Biomedical Instrumentation and Measurements‖, 2nd Edition, Prentice Hall of India, 1999.
3. Tompkins W.J., ―Biomedical Digital Signal Processing: Principles and Techniques‖, Prentice Hall of India, 1998.

U18PRMT8P2	**PROJECT WORK-II**	**L**	**T**	**P**	**C**
	Total Contact Hours –18 periods per week	0	0	18	9
	Prerequisite – Professional Courses				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

COURSE OUTCOMES (COs)

CO1	Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
CO2	This final report shall be typewritten form as specified in the guidelines.
CO3	The continuous assessment shall be made as prescribed in the regulations.
CO4	The student can able to design the components they required
CO5	Understand the different fabrication processes.
CO6	Will gain confidence to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H							M			L	
	CO2	H						H	M	H		L	
	CO3			H	H	H		H				L	
	CO4					M		H		M		L	
	CO5					M							
	CO6						M	H	M				

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	
									√	
4	Approval	47th Academic Council, July 2018								

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to undergo learning in research oriented areas, collecting survey and documents on the growing fields in technology

The students as an individual will choose one topic which will be the topic of his project work in the final semester. Every project work shall have a guide who will be the faculty of the institution.

The topic chosen may be related to small machine elements (Example- screw jack, coupling, machine vice, cam and follower, governor etc) attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic/pneumatic devices etc.

The student is required to collect literature survey regarding the selected topic to be extended in the next semester. He has to demonstrate its working apart from submitting the project report. The report should contain study material, literature and whatever further deemed important related to his work.

U18PCMT8C1	**COMPREHENSION**	**L**	**T**	**P**	**C**
	Total Contact Hours : Test will be conducted at the end of the semester	0	0	1	1
	Prerequisite – All the courses up to seventh semester				
	Course Designed by – Department of Mechatronics				

OBJECTIVES

- To provide a complete review of Mechatronics topics covered up to seventh semesters, so that a comprehensive understanding is achieved.
- It will also help students to face job interviews, competitive examinations and also to enhance the employment potential.
- To provide overview of all topics covered and to assess the overall knowledge level up to seventh semester.

18MCAB815	**INNOVATION - PROJECT BASED – SC., TECH, SOCIAL, DESIGN & INNOVATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently able people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance

ELECTIVES

PROFESSIONAL ELECTIVE –I

U18PEMT011	**COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Fundamentals of Electronic Circuits and Devices				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about the analog and digital communication and also study about the real time application and Satellite communication.				

Unit I Analog Communication 9

AM – Frequency Spectrum – Vector Representation – Power Relations – Generation Of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – Frequency Spectrum – Power Relations : NBFM & WBFM, Generation Of FM and DM, Amstrong Method & Reactance Modulations : Fm & Pm Frequency.

Unit II Digital Communication 9

Pulse Modulations – Concepts of Sampling and Sampling theorems, PAM, PWM, PPM, PTM, Quantization and Coding: DCM, DM, Slope Overload Error. ADM, DPCM, OOK SYSTEMS – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, Applications Of Data Communication.

Unit III Source Codes, Line Codes & Error Control 9

Primary Communication – Entropy, Properties, BSC, BEC, Source Coding: Shaum, Fao, Huffman Coding: Noiseless Coding Theorum, BW – SNR Trade Off Codes: NRZ, RZ, AMI, HDBP, ABQ, MBnbcodes: Efficiency Of Transmissions, Error Control Codes And Applications: Convolutions & Block Codes.

Unit IV Multiple Access Techniques 9

SS&MA Techniques: FDMA, TDMA, CDMA, SDMA Application In Wire And Wireless Communication: Advantages (Merits):

Unit V Satellite, Optical Fiber – Power line, Scada 9

Orbits: Types Of Satellites: Frequency Used Link Establishment, Ma Techniques Used In Satellite Communication, Earth Station; Aperture Actuators Used In Satellite – Intelsat And Insat: Fibers – Types: Sources, Detectors Used, Digital Filters, Optical Link: Power Line Carrier Communications: Scada.

TEXT BOOKS:

1. Taub & Schiling “Principles of Communication Systems” Tata McGraw Hill 2007.
2. J.Das “Principles of Digital Communication” New Age International, 1986.

REFERENCES:

1. Kennedy and Davis “Electronic Communication Systems” Tata McGraw hill, 4th Edition, 1993.
2. Sklar “Digital Communication Fundamentals and Applications“Pearson Education, 2001.
3. Bary le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.
4. B.P.Lathi “Modern Digital and Analog Communication Systems” Oxford University Press, 1998.

COURSE OUTCOMES (COs)	
CO1	To learn basics about Analog Communication.
CO2	To learn about transducers in Digital Communication.
CO3	To learn about Source Codes, Line Codes & Error Control.
CO4	To learn about Multiple Access Techniques
CO5	To understand the Satellite, Optical Fiber – Power line, Scada

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M				H				
	CO3				M	H		M					
	CO4								H		M	M	
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT012	**MECHANICS OF SOLIDS AND FUNDAMENTALS OF FLUIDS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	0	0	3
	Prerequisite – Engineering Mathematics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of various mechanism in solids and fundamentals about fluids				

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

Concept of stress-strain- Hooke's law- Tension- Compression and shear- Stress strain diagram, poisson's relation-Volumetric strain- Elastic constants and their relation- Stress in simple and composite bars subjected to axial loading and temperature- State of stress at a point-Principle plane- Principle stress-Normal and longitudinal stresses on a given plane-Mohr's circle of stresses.

UNIT II TRANSVERSE LOADING ON BEAMS, SHEAR FORCE AND BENDING MOMENT 12

Types of Beams- Transverse loading on beams shear force and Bending moment in beams – Cantilever-Simply supported, overhanging beam subjected to concentrated load and UDL – Maximum bending moment and point of contra flexure-Theory of simple bending and assumption – Derivation of formulae M/I = F/Y = E/R and its applications to engineering – Leaf spring.

UNIT III TORSION, SPRINGS AND COLUMNS 12

Theory of torsion and assumption – Torsion of circular shafts- solid & hollow – strain energy in torsion-Power transmission- Strength and stiffness of shafts- Types of springs- Stiffness stresses and deflection in helical spring- Columns – Buckling and stiffness due to axial loads – Euler, Rankin and Empirical formulae for columns with different conditions.

UNIT IV FLUID FLOW CONCEPTS AND DYNAMICS OF FLUIDS 12

Flow characteristics- Concepts of system and control volume –Continuity equation – Application of control volume to continuity – Energy Equation – Euler's Equation – Bernoulli equation and Momentum Equation – simple problems.

UNIT V DIMENSIONAL ANALYSIS AND FLOW THROUGH CIRCULAR CONDUITS 12

Dimension and units, Buckingham's Π theorem- Boundary layer concepts- Boundary layer thickness-Darcy-Weisbach equation- Friction factor and Moody diagram-Commercial pipes- Minor losses- Flow though pipes in series and in parallel.

TEXT BOOKS

1. Ramamurtham.S and Narayanan.R, "Strength of material", DhanpatRai Pvt. Ltd., New Delhi, 2001.

2. Bansal.R.K, “Strength of Material”, Laxmi publications Pvt. Ltd., New Delhi, 6th Edition,2017.
3. Kumar.K.L, “Engineering Fluid Mechanics”, Eurasla publishers Home Ltd., New Delhi, 1995.
4. Bansal.R.K, “Fluid Mechanics and Hydraulic Machines”,Laxmi publications (P) Ltd., New Delhi, 1995.
5. Popov.E.P, “Mechanics of Materials”, Prentice Hall, 1982.
6. Timoshenko.S.P and Gere .M.J, “Mechanics of Materials”, C.B.S. publishers, 1986.

REFERENCE

1. Ferdinand P. Beer and Russell Johnston.E, “Mechanics of Materials”, SI metric Edition McGraw Hill, 1992
2. R.K.Rajput,”Strength of Materials:Mechanics of Solids,S.Chand,2006.
3. Srinath.L.N, “Advanced Mechanics of Solids”,Tata McGraw Hill Ltd., New Delhi.
4. Ramamurthan.S, “Fluid Mechanics and Hydraulics”, DhanpatRai and Sons, Delhi, 1988.

Fox R.W and Mc. Donald .A.T, “Introduction to fluid Mechanics”, 5th Ed. John Wiley and Sons, 1999

COURSE OUTCOMES (COs)	
CO1	To understand the different types of beams and bending moment and shear force
CO2	To learn the power transmission and strain energy and stiffness and buckling
CO3	To learn the flow characteristic fluid continuity, Euler’s equation
CO4	To learn the principles of dimensional analysis
CO5	To learn the various applications of solids and fluids mechanism

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M		L	H	L						
	CO2	H	M		L	H	L						
	CO3	H	M		L	H	L						
	CO4	H	M		L	H	L						
	CO5	H	M		L	H	L						
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT013	VIRTUAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Fundamentals of computing and programming, Design of Mechatronics System.				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the Virtual Instrument. To study of LABVIEW software and about image processing				

UNIT I INTRODUCTION TO VIRTUAL INSTRUMENTS 9

Historical perspective and traditional bench-top instruments - General functional description of a digital instrument- Block diagram of a Virtual Instrument – Physical quantities and analog interfaces- Hardware and Software – User Interfaces –Advantages of Virtual Instruments over conventional instruments – Architecture of a Virtual Instruments and its relation to the operating system.

UNIT II LABVIEW GRAPHICAL PROGRAMMING 9

LabVIEW – graphical user interfaces- controls and Indicators – 'G' programming –data types –data flow programming –Editing Debugging and Running a Virtual Instrument –Graphical programming palettes and tools – Front panel objects – Function and Libraries.

UNIT III LABVIEW BASIC PROGRAMMING 9

FOR Loops, WHILE loops, Shift Registers, CASE structure, formula nodes-Sequence structures- Arrays and Clusters- Array operations – Bundle, Unbundle – Bundle/Unbundle by name, graphs and charts – string and file I/O – High level and Low level file I/Os – attribute nodes local and global variables.

UNIT IV BASICS OF DAQ 9

Basics of DAQ Hardware and Software – Concepts of Data Acquisition and terminology – Installing Hardware, Installing drivers -Configuring the Hardware – addressing the hardware in LabVIEW- Digital and Analog I/O function – Buffered I/O – Real time Data Acquisition.

UNIT V COMMUNICATION 9

Simple programs in VI- Advanced concepts in LabVIEW- TCP/IP VI's, Synchronization – other elements of Virtual Instrumentation – Bus extensions – PXI - Computer based instruments - Image acquisition – Motion Control.

TEXT BOOKS

1. Garry M. Johnson "Lab VIEW Graphical Programming", Tata McGraw-Hill, 5th Edition, 2009
2. Lisa.K.Wills, "LabVIEW for Everyone" Prentice Hall of India, 2009.

REFERENCES

1. Labview Basics I and II Manual, National Instruments, 2009
2. Barry Paton, "Sensor, Transducers and Lab VIEW", Prentice Hall, 2007.

COURSE OUTCOMES (COs)	
CO1	To introduce the virtual instrumentation
CO2	To learn about LABVIEW
CO3	To learn array operation
CO4	To learn basic DAQ hardware and software
CO5	To learn image acquisition

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H									
	CO3		M		H								
	CO4					M	H						
	CO5							H	H				
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT014	**PROCESS AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Control system				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To obtain the mathematical models for first order and higher order real-time systems and also understand the concept of self-regulation and to get adequate knowledge				

	about the characteristics of various controller modes and controller tuning methods

UNIT I INTRODUCTION **9**

Need for process control - Continuous and batch process - Mathematical model of first order level:pressure and thermal processes, interacting and non-interacting systems - Servo and regulator operation - self-regulation

UNIT II CONTROLLER CHARACTERISTICS **9**

Basic control actions - Characteristics of On-Off, proportional, integral and derivative control modes - Composite control modes: P+I, P+D and P+I+D control modes - Selection of control mode for different processes typical control schemes for level, flow, pressure and temperature processes.

UNIT III TUNING OF CONTROLLERS AND MULTI-LOOP CONTROL 9

Optimum controller settings - Evaluation criteria-IAE, ISE and ITAE decay ratio - Tuning of

controllers by process reaction curve method, damped oscillation method Ziegler-Nichol's tuning,feed forward control - ratio control, cascaded control, averaging control, inferential and split rangecontrol.

UNIT IV FINAL CONTROL ELEMENT **9**

Pneumatic and electric actuators - Valve positioner - Control valve characteristics - Type of valves:globe, butterfly, diaphragm, ball valves and control valve sizing cavitation and flashing in controlvalves - Response of control valves - Electric and electro pneumatic valves - Selection of controlvalves

UNIT V SELECTED UNIT OPERATIONS **6**

Distillation column control of top and bottom product compositions reflux ratio. Case study: controlof CSTR, control of heat exchanger, Steam boiler: drum level control and combustion control.

TEXT BOOKS

1. George Stephanopoulos, Chemical Process Control, Prentice Hall of India learning Pvt. Ltd.,

New Delhi, 2012

REFERENCE

1. Donald P. Eckman, Automatic Process Control, Wiley-India Pvt. Ltd., New Delhi, 2009
2. Dale E. Seborg, D. A. Mellichamp and Thomas F Edgar, Process Dynamics and Control, Wiley-India, 2010.

3. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008
4. S B Thakore and B I Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill PublishingCo. Ltd., New Delhi, 2008.
5. B. Wayne Bequette, Process Control: modeling, design, and simulation, Prentice Hall of IndiaLearning Pvt.Ltd., New Delhi, 2008

COURSE OUTCOMES (COs)		
CO1	Solve the mathematical models for first order real time systems.	
CO2	Understand the characteristics of various control modes and the concept of various control schemes	
CO3	Understand the various controller tuning methods to tune the controller.	
CO4	Know the construction, characteristics and applications of different type of actuators.	
CO5	Learn about final control elements used in process control	

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L					
	CO2		L										
	CO3				H	M	M						
	CO4	M				H	L						
	CO5	M	L		M	H	H	L					
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

PROFESSIONAL ELECTIVE-II

U18PEMT021	**CONSUMER ELECTRONICS**	**L**	**T**	**P**	**C**

	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the operation of audio, video systems. To learn the operation of various memory devices and various switching systems. Able to conduct experiments on electrical machines and analyze the experimental data				

UNIT I AUDIO SYSTEM 9

Hi-Fi systems, stereophonic sound system, public address systems, Acoustics, Quadraphonic sound systems, Graphics Equalizer, Electronic tuning, Digital sound recording on tape and disc..

UNIT II VIDEO SYSTEMS 9

B & W TV, colour TV and HD TV systems, Electric cameras, VCR, VCP, Block diagram and principles of working of cable TV and DTH, cable TV using internet.

UNIT III MEMORY DEVICES 10

CD systems, Memory diskettes, Discs and drums vide monitoring audio, video recording media & Systems.

UNIT IV SWITCHING SYSTEMS 9

Dolby noise reduction digital and analog recording. Switching Systems: Switching systems for telephone exchange, PAB EPRABX, modular telephones, Telephone message recording concepts, remix controlled systems.

UNIT V HOME APPLIANCES 8 Electronic toys, microwave oven, Refrigerators, washing machines, calculator, data organizers

TEXT BOOKS

1. Gulati.R.R, Monochrome and color television, New age publisher.2nd Edition
2. Encyclopedia of video & TV / Focal press

REFERENCES

1. Complete Satellite & cable Television R.R Gulati New age International Publisher.
2. Handbook of Electronics & Telecommunication.

COURSE OUTCOMES (COs)	
CO1	To learn various sound systems like stereophonic, Quadraphonic, recording
CO2	To learn various video systems like cameras, VCR, VCP, TV etc
CO3	To study various memory devices like CD, HDD etc
CO4	To learn switching system in telephone exchange
CO5	To study the home appliances like oven, Refrigerators, washing machines

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					H
	CO2	M			M					H	H		
	CO3						M		H				
	CO4					H				L	L		M
	CO5				M					L	H		
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PCMT022	DIMENSIONAL METROLOGY	L	T	P	C
	Total Contact Hours -45	3	0	0	3
	Prerequisite – Engineering Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce concept of metrology and measurement, measurement systems, metrological equipments.				

UNIT I BASICS OF MEASUREMENT & METROLOGY 9

Measurement & Metrology – Introduction, uses, acts and applications of measurement, codification of measurement – Accuracy, precision and reliability – Evolution of standards – metric systems – fundamental & Practical Criteria – metrological, communication and computational considerations – Rounding of numerical values. Measurements and Tolerances – Geometric Dimensioning and Tolerance – Statistics and metrology – probability and acceptance sampling.

UNIT II MEASUREMENT INSTRUMENTS 9

Measurement with scales and scaled Instruments – steel rule – role of error – calipers – types and applications.Vernier Instruments – Vernier Caliper, Department h gauge, Height gauge – height master – Three elements of measurements. Micrometer Instruments – Principle, Types, applications. Development and use of gauge blocks – Calibration, applications, combining gauge blocks.

UNIT III MEASUREMENT METHODS 9

Measurement by comparison – Dial Indicator – Principle, selection, use and Calibration – Accessories and attachments – constructive use of Error. High – Amplification comparators – Electronic measurement – applications – advantages of multiple scales. Pneumatic measurement – Principles, applications and advantages of pneumatic comparators – Calibration – Role of error, Calibration Procedure.

UNIT IV OPTICAL MEASUREMENT METHODS 9

Optical Flats and Optical alignment – light waves as standards – measurement with optical flats, applications of optical flat measurement – principles of optical metrology – Alignment Telescope – Straightness measurement – Optical squares and squareness measurement – Sight level – Plumbness, optical polygons – Angles, Jig Transit – Planes, Theodolite Angles and planes. Reference planes-Flatness, Perpendicularity and modern reference planes. Angle measurement-Basic geometry function, sign bars and plates and mechanical angle measurements.

UNIT V SURFACE MEASUREMENT METHODS 9

Surface Measurement – surface Evaluation, stylus method, Numerical values for surface Assessment, surface Texture specimens, surface Evaluation, other methods, Roundness measurement. Coordinate measuring machines – types, operational details and metrological features – coordinate systems. Non-contact type measurement – Principles of microscope, applications, optical comparator, profile projector, machine vision systems, Laser measurement.

TEXTBOOKS

1. Connie Dotson, Ronger Harlow and Richard L. Thomson, "Fundamentals of Dimensional metrology", 5th Edition, 2009. Thomson Asia Pvt. Ltd. Singapore. ISBN 981-243-685-5.

REFERENCES

1. R.K. Jain, "Engineering Metrology", Khanna Publishing, 2002.
2. Connie Dotson,"Dimensional Metrology", 1st Edition,2012.
3. Raghavendra,"Engineering Metrology and Measurements",Oxford Higher Education,2013.
4. Gaylor, Shotbolt and Sharp, "Metrology for Engineers, O.R. Cassel, London, 1993.
5. Thomas, "Engineering Metrology", Butthinson& Co., 1984.

COURSE OUTCOMES (COs)	
CO1	To explain the concept of metrology and measurement and various terms used in the metrology
CO2	To understand the vernier caliper, micrometer and gauge block
CO3	To explain the measurement by comparison
CO4	To explain the optical metrology
CO5	To explain the surface measurement

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					H
	CO5												
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT023	TEXTILE MECHATRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about the basics processes involved in textile technology				

UNIT I INTRODUCTION TO TEXTILE TECHNOLOGY AND SPINNING 9

History of textile technology and its advancements, introduction to textile fibers, overview of

textile manufacturing, Introduction to automation in textile industries.

Spinning process flow chart – Objectives and process variables of textile spinning machineries:Mixing, Blow room, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning.

UNIT II BASICS OF WEAVING 9

Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding,Warping, Sizing and beaming. Objectives and process variables in weaving: drawing in,knotting, denting and weaving.

UNIT –III BASICS OF PROCESSING 9

Objectives and process variables in processing machines: Singeing, Desizing, Scouring,

Bleaching, Mercerizing, Dyeing, Printing, Finishing.

UNIT-IV AUTOMATION IN SPINNING MACHINERY 9

Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers –Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning – rotor spinning.

UNIT-V AUTOMATION IN WEAVING MACHINERY 9

Yarn cleaner controls – Knotter / splicer carriage controls – Warping machine monitors and

controls – sizing machine monitors and controls – Auto reaching / drawing in and knotting

machine monitors and controls – Data acquisition system in weaving preparatory and weaving – humidification systems .CAD / CAM / CIM in spinning, Weaving, Dyeing, Printing, Apparel production – Electronics data interchange - Robotics in textile industries

TEXTBOOKS

1. Chattopadhyay R. (Ed), “Advances in Technology of Yarn Production”, NCUTE, IIT Delhi,

2002.

2. Oxtoby E “Spun Yarn Technology” butter worth‟s, London, New Edition 2002.

3. Lord P.R. and Mohammed M.H., “Weaving – Conversion of Yarn to Fabric”, Merrow

Publication, 2001.

REFERENCES

1. Krishna Kant, “Computer – Based Industrial Control”, PHI Learning Pvt Ltd, 2nd edition,

New Delhi, 2011.

2. Venkatachalam. A and Ashok Kumar L, “Monograph on ― Instrumentation & Textile

Control Engineering” – 2005.

3. Berkstresser G A, Buchanan D R and Grady P, “Automation in the Textile Industry from

Fibers to Apparel", The Textile Institute, UK, 1995.

COURSE OUTCOMES (COs)	
CO1	To know the evolution of textile technology and manufacturing with textile fibers
CO2	To describe various process and machines involved in spinning
CO3	To learn the various process and machines involved in weaving.
CO4	To study the various stages of automation scopes in spinning and weaving.
CO5	To learn the role of computers in automated textile manufacturing

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		H	H									
	CO2		H	M									
	CO3		H	L	M	H							
	CO4		H										
	CO5		H		H	L							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT024	**PLANT LAYOUT AND MATERIAL HANDLING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Manufacturing Technology				
	Course Designed by – Department of Mechanical Engineering				

	OBJECTIVES
	To equip students with adequate knowledge for running an organization and to understand the integration of material handling systems.

	COURSE OUTCOMES (COs)	
CO1		Understand the procedures for systematic integration of organization.
CO2		Will understand various techniques and tools of layout planning.
CO3		Students will be able to get knowledge on industrial layouts.
CO4		Understand material handling systems
CO5		Learn the concepts of industrial building
CO6		Learn the concepts of industrial utilities
	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

UNIT I **8**

Plant Location: Factors to be considered – influence of location on plant layout, selection of plant site, Consideration in facilities planning and layout. Equipments required for plant operation, Capacity, serviceability and flexibility and analysis in selection of equipments, space requirements, and man power requirements.

UNIT II **8**

Plant layout: Need for layout, types of layout, factors influencing product, process. Fixed and combination layout: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure. Visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

UNIT III **10**

Importance and scope. Principles of material handling. Planning, operating and costing Principles, types of material handling systems, factors influencing their choice. Assembly practices: Manufacturing and assembly, process planning, selective assembly.

UNIT IV **12**

Industrial building and utilities: Centralized electrical, pneumatic water line systems. Types of buildings, lighting, heating, air conditioning and ventilation utilities - planning and maintenance,

waste handling, statutory requirements. Packing and storage materials: Importance of Packaging, layout for Packaging – Packaging machinery – wrapping and Packing materials, cushion materials.

UNIT V **7**

Motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys.

TEXT BOOKS :

1. Agarwal, Plant layout and material handling, Jain brothers publication.
2. Sharma S.C, Plant layout and material handling, Khanna publishers.

REFERENCES :

1. Oberman. Ya, Material handling, Mir publishers.1980
2. Sharma S.C, Material Management And Material Handling, Khanna Publishers.1995.
3. Shubin J A, Plant layout, P H I publications.1965
4. https://books.google.com/.../**Plant_Layout_and_Material_Handling**.html?...

1	COs/POs	a	b	c	d	e	f	G	H	i	J	K	l
2	CO1	H											
	CO2	H		H				L					
	CO3	H		H		M	M			L		L	
	CO4	H		H									
	CO5	H					M		M				
	CO6	H		H									

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	
						√				
4	Approval		38th Meeting of Academic Council, July 2018							

PROFESSIONAL ELECTIVE –III

U18PEMT031	**NEURAL NETWORK & FUZZY LOGIC**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To introduce the neural network, associative memories and fuzzy logic system				

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Essentials of Artificial Neural Networks. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy . (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT II FEED FORWARD NEURAL NETWORKS: 9

Single Layer Feed Forward Neural Networks- Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model. Multilayer Feed forward Neural Networks-Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT III ASSOCIATIVE MEMORIES `9

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis.

UNIT IV CLASSICAL & FUZZY SETS 9

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzy Logic System Components.Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT V APPLICATIONS 9

Neural network applications: Process identification, control, fault diagnosis. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

TEXT BOOKS

1. S. Rajasekharan and G. A. Vijayalakshmipai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2004.

REFERENCES:

1. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2001.2nd Edition.

2. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TMH, 2006.

3. James A Freeman and Davis Skapura, Neural Networks Pearson Education, 2002.

4. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", McGraw-Hill Inc. 1997.3rd Edition.

5.John Yen and Reza Langan, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education,2004.

COURSE OUTCOMES (COs)	
CO1	To learn basics of neural networks.
CO2	To learn about feed forward neural network.
CO3	To learn about associative memories
CO4	To learn about classical and fuzzy sets.
CO5	To learn about application of neural networks and fuzzy logic.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	
	CO5							H	H			H	
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT032	COMPOSITE MATERIALS AND STRUCTURE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engineering Mathematics, Engineering Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions				

UNIT I MICROMECHANICS 10

Introduction – advantages and application of composite materials – types of reinforcements and matrices – micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. effect of voids in composites.

UNIT II MACROMECHANICS 10

Generalized Hooke's Law – elastic constants for anisotropic, orthotropic and isotropic materials – macro

mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina – experimental characterization of lamina. failure theories of a lamina. hygrothermal effects on lamina.

UNIT III LAMINATED PLATE THEORY 1**0**

Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. impact resistance and interlaminar stresses. netting analysis

UNIT IV FABRICATION PROCESS AND REPAIR METHODS 8

Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTIONS 7

Basic design concepts of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels – bending stress and shear flow in composite beams.

TEXT BOOKS

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
2. MadhujiMukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCE

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
4. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, II Edition, 1999.

COURSE OUTCOMES (COs)	
CO1	To learn the basics of composite materials.
CO2	To learn about macro mechanics
CO3	To learn about micromechanics
CO4	To learn about laminate plate theory
CO5	To learn about fabrication process and repair methods.
Mapping of Course Outcomes(COs) with Programme Outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		H			H							
	CO2						M						
	CO3		H	L	L	H							
	CO4				M		M						
	CO5			L	H	M							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT033	**UNDERWATER ROBOTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Transducer				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The course should enable the students to demonstrate knowledge and understanding of Underwater robotic systems in operation and their applications.				

UNIT 1: INTRODUCTION TO UNDERWATER ROBOTICS 8

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - why it is called an perfect engineering product - Overview about Environmental Factors affecting object in water

UNIT 2: CONTROL OF THE UNDERWATER ROBOTICS 10

Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Applications of Underwater Vehicles APPLICATION DEVELOPMENT - ASSIGNMENT (1 HOUR)

UNIT 3: ENGINEERING CONCEPTS IN UNDERWATER ROBOTICS 8

Introduction to Fluid Dynamics - Studying of FD Model - Computation Fluid Dynamics on Water Bodies Introduction to Hydraulics - Hydraulics Acting on an Object - Hydraulics as Underwater Pressure

Compensator Introduction to Pressure Dynamics - Buoyancy Concept - Studying various Polymers in Buoyancy and Pressure Calculations Introduction to Electrical Power Driven Systems - Studying Different Types - PLC and HMI Interface Systems an Overlook - Electrical Archaeology of Systems ANALYSIS & DEVELOPMENT MODULES - ASSISGNMENT (2 HOURS)

UNIT 4: AUTONOMOUS UNDERWATER SYSTEM 8

Introduction to AUVS - Development of AUV / ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used

UNIT 5: APPLICATIONS OF UNDERWATER ROBOTICS 8

Case Studies and procedure for design of under water robots

TEXTBOOK

1. GianlucaAntonelli "Underwater Robots (Springer Tracts in Advanced Robotics)", Springer; 3rd ed. 2014 edition

REFERENCES

1. GianlucaAntonelli, Underwater Robots: Motion and Force Control of Vehicle-Manipulator Systems (Springer Tracts in Advanced Robotics), Springer; 3rd ed. 2014 edition

2. Steven W. Moore, Harry Bohm, and Vickie, "Underwater Robotics: Science, Design & Fabrication" MATE Center,2013

COURSE OUTCOMES (COs)	
CO1	Select the components for design of underwater robotics.
CO2	Design, configuration and operation of platforms, both autonomous underwater vehicles (AUVs) and Remotely Operated Vehicles (ROVs).
CO3	Use and interpretation of sensor data for control applications
CO4	Know the procedure of Maneuvering simulations of underwater robots.
CO5	Software architectures for maritime robots.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1					H		M					
	CO2	M			M						H		
	CO3						M		H				
	CO4					H					L		
	CO5				M						H		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT034	BUILDING AUTOMATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	Provide the student with an advanced knowledge base and understanding of the design, simulation and safety of Building Automation System (BAS).				

UNIT 1 INTRODUCTION **9**

Introduction to Building Automation System, Features, Characteristics, Drawbacks of Building Automation system.Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System.

UNIT 2 BUILDING MANAGEMENT SYSTEM **9**

Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Concept of Controller IOs, Std Signals, Signal Compatibility between Controller & Field Devices. AHU – Concept, Components, Working Principle.AC Plant Room – Concept, Components, Refrigeration Cycle Working Principle, Chiller Sequencing, AC Plant Sequencing. Feedback Control Loops, Heat – Types, Heat Transfer Principles, Measurement of Heat Transfer. Psychrometry– Concept, ASHRAE Psychrometric Chart, Meaning of Various Terms – DBT, WBT, ST, RH, DPT, Sensible & Latent Cooling & Heating, Numericals. Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI.Logic Examples, CL Programming.

UNIT 3 ENERGY MANAGEMENT SYSTEM **9**

Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of

Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving.

UNIT 4 SAFETY SYSTEMS **9**

Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming.

UNIT 5 INTEGRATED SYSTEMS 9

Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems

TEXT BOOK

1. Reinhold A. Carlson Robert A. Di Giandomenico, 'Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building', 1 st edition (R.S. Means Company Ltd), (1991)

REFERENCE

1. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub.by R.S. Means Company, 1991.
3. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.
4. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition, 2007.
5. HVAC Controls and Systems by Levenhagen, John I.Spethmann, Donald H., McGraw-Hill Pub.
6. HVAC Control in the New Millennium by Hordeski, Michael F, Fairmont press, 2001.
7. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co.

COURSE OUTCOMES (COs)	
CO1	Select and evaluate the different transducers, actuators, AC, refrigeration systems in modern Buildings
CO2	Identify the importance and techniques of energy conservations in BAS for simple applications
CO3	Design and installation methods of safety sensors for simple application

CO4	Know the procedure for integrated and secure smart building techniques
CO5	Identify and describe the basic mechanical components and controls in an HVAC control system

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	M			M						H		
	CO3						M		H				
	CO4					H					L		
	CO5				M						H		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

PROFESSIONAL ELECTIVE-IV

U18PEMT041	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engineering Mathematics				
	Course Designed by – Department of Mechatronics Engineering				
OBJECTIVES	To learn the operation of various DSP devices. To understand the Design Algorithm of various filters				

UNIT I CLASSIFICATION OF SIGNALS 9

Characterization and classification of signals – examples of signals – continuous versus discrete – analog versus digital – advantages of digital signal processing compared with analog processing- Sampling of Analog Signals – Aliasing. Linear Time Invariant Systems (LTIS) – Linearity – Time Invariant – Causality – stability – Response of CT – LTI System using Convolution Integral Response of DT – LTI system using convolution SUM – Finding Impulse Response of LTI using Laplace Transform – Z – Transform & its Properties- Finding Impulse Response of DT – LTI system using Z – transform.

UNIT II FAST FOURIER TRANSFORM 9

Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in signal analysis. Spectrum of D.T. signals, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT) – Introduction to radix – 2 FFT – DIT & DIF radix 2 FFT.

UNIT III FIR FILTER DESIGN 9

FIR Filters: Design of Filters – Frequency selective filters – Linear filtering – Structures for FIR – Design of FIR Filters – using windows – Frequency Sampling – Linear phase FIR Filters.

UNIT IV DIGITAL FILTER DESIGN 9

Review of design of analogue Butter worth and Chebyshev Filters, Frequency transformation in analogue domain – design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – Pre warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

UNIT V DSP PROGRAMMING *9*

Effect of Number representation on Quantization – Overflow – Need for scaling – truncation error – coefficient Quantization error – limit cycle oscillations. Multichannel – Multi – dimensional – typical applications of DSP – Introduction to Programmable DSP – Instruction set of TMS 320C50.

TEXT BOOKS

1. Sanjith K. Mitra "Digital Signal Processing", Tata McGraw–Hill, New Delhi, 3rd Edition, 2007.

REFERENCES

1. Allan V.Oppenheim& Donald W. Schafer, "Digital Signal Processing", PHI of India, 1989.
2. Texas Instruments, User Guide TMS 320C50.
3. Ludemann L.C. "Fundamentals of Digital Signal Processing", John Wiley Inc., 1992.
John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Algorithms and Application", PHI of India Ltd., New Delhi 3rd Edition 2000.

COURSE OUTCOMES (COs)	
CO1	To learn about Characterization and classification of signals
CO2	To learn about Discrete Fourier Transform (DFT)
CO3	To study about Various design method of FIR Filters
CO4	To study about Various design method of IIR Filters
CO5	To Study about Various Digital Signal Processors
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	M			M			H					
	CO3						M		H				
	CO4					H		M			L		
	CO5				M		H		M	H			
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT042	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Manufacturing Technology, Engineering Chemistry				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The students are trained to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications				

UNIT I INTRODUCTION **6**

Unconventional machining Process – Need – classification – Brief overview.

UNIT II MECHANICAL ENERGY BASED PROCESSES **9**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES **9**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 11

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications.

UNIT V THERMAL ENERGY BASED PROCESSES 10

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOOKS

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. McGeough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

COURSE OUTCOMES (COs)	
CO1	To learn about various unconventional machining processes
CO2	To understand the basic mechanical machining processes
CO3	To understand the basics of electrical discharge machine and related parameters
CO4	To learn the important concepts of chemical machining processes
CO5	To study about the electro chemical machining process and the various parameters associated to it.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H	L	M					

	CO2	H			H						M		
	CO3			M			H		M				
	CO4					H							
	CO5			M	L						M		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT043	**COGNITIVE ROBOTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Robotics & Machine Vision System				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To understand the cognitive mechanisms adopted by the robot				

UNIT 1: CYBERNETIC VIEW OF ROBOT COGNITION AND PERCEPTION 6

Introduction to the Model of Cognition,Visual Perception,Visual Recognition,Machine Learning,Soft Computing Tools and Robot Cognition

UNIT 2: MAP BUILDING 12

Introduction, Constructing a 2D World Map,Data Structure for Map Building,Explanation of the Algorithm, An Illustration of Procedure Traverse Boundary,An Illustration of Procedure Map Building ,Robot Simulation, Execution of the Map Building Program

UNIT 3: RANDOMIZED PATH PLANNING 9

Introduction, Representation of the Robot's Environment, Review of configuration spaces, Visibility Graphs, Voronoi diagrams, Potential Fields and Cell Decomposition, Planning with moving obstacles, Probabilistic Roadmaps, Rapidly exploring random trees, Execution of the Quad tree-Based Path Planner Program

UNIT 4: SIMULTANEOUS LOCALIZATION AND MAPPING (SLAM) 12

Problem Definition, Mathematical Basis, Example: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter, Graph-Based Optimization Techniques, Particle Methods Relation of Paradigms

UNIT 5:ROBOT PROGRAMMING PACKAGES 6

Robot Parameter Display, Program for Bot Speak, Program for Sonar Reading Display, Program for Wandering Within the Workspace, Program for Tele-operation, A Complete Program for Autonomous Navigation

TEXT BOOKS:

1.Patnaik, Srikanta, "Robot Cognition and Navigation An Experiment with Mobile Robots",Springer-Verlag Berlin and Heidelberg,2007.

2.Howie Choset, Kevin LynchSeth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge,2005.

REFERENCES:

1.Sebastian Thrun, Wolfram Burgard, Dieter Fox, "ProbabilisticRobotics", MIT Press, 2005.

2.Margaret E. Jefferies and Wai-Kiang Yeap,"Robotics and Cognitive Approaches to Spatial Mapping", Springer-Verlag Berlin Heidelberg 2008

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of cognitive processes.
CO2	To learn about the map building methods.
CO3	To study about the path planning procedure
CO4	To study about the SLAM technique
CO5	To study about the Programming packages

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H	M			H	H	M	H
	CO2					H					H		
	CO3		M		H	H		M		H	H		M
	CO4				M	H				M	H		
	CO5					H					H		

3	Category	Professional Elective(PE)
4	Approval	47th Meeting of Academic Council, July, 2018

U18PEMT044	INDUSTRIAL AUTOMATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Applied Hydraulics and Pneumatics, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the basic concepts and components of sensors, switching elements .To learn the automation concepts based on industrial applications				

UNIT I INTRODUCTION-ACTUATORS AND SENSORS 9

Actuators: Types of motion Conversion- Electric Linear actuators-Electric Rotary Actuators- Fluid Power Linear Actuators-Fluid power Rotating Actuators

Sensors: Binary Position Sensors-Pneumatic Position Sensors-Comparison between different position sensors-Point sensors for variables other than position

UNIT II SWITCHING THEORY 10

Binary Elements-variables-basic logic gates-Basic theorems-K Map- Practical examples of switching systems –Timers-counters-Schmitt triggers-encoders-parity detector-binary comparator

UNIT III SEMI FLEXIBLE AUTOMATION 8

Drum Programmers-Programmable Timers and Limit Switches-Card and Tape recorders-Matrix boards-Programmable counters.

UNIT IV FLEXIBLE AUTOMATION 9

PLC construction-Programming PLC- Ladder diagrams for PLC-PLC vs. Relay-PLC applications-Microcomputer architecture-Ramping a step motor-Assembly language Programming.

UNIT V ASSEMBLY AUTOMATION 9

Non Vibratory Feeding and orientation Devices-Vibratory feeding and orienting Devices-Parts Transfer-NC systems-Robot grippers-Robot Sensors-Robot Programming

TEXT BOOK:

1. David W.Pessen, Industrial Automation – Circuit design and components, Willey, India Edition, 2011.

REFERENCES :

1. David W.Pessen, Industrial Automation: Circuit design and components, Wiley indiaPvt.Ltd, 2011.

2. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)

3. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.

4. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.

COURSE OUTCOMES (COs)	
CO1	To introduce the actuators ,Sensors and its components
CO2	To explain the various methods of Switching theory
CO3	To explain the various miscellaneous switching elements
CO4	To explain the programmable controllers and Microcomputers
CO5	To introduce assembly automation

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	H			M						H		
	CO3			L			H		L				
	CO4					H					M		
	CO5			L	M						H		
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

PROFESSIONAL ELECTIVE-V

	DIGITAL IMAGE PROCESSING	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Robotics & Machine vision system				

U18PEMT051	Course Designed by – Department of Mechatronics
OBJECTIVES	To introduce the basic concepts of Digital Image Processing and various techniques used to resolve the images

UNIT I FUNDAMENTALS 8

What is Digital image processing, Examples (Briefly), Components of Image Processing System, Light and electromagnetic spectrum, Image Sensing and Acquisition, Simple Image Formation Model, Image Sampling and Quantization:- Representing Digital Images, Spatial and Grey level Resolution, Basic Relationship Between Pixels.

UNIT II IMAGE ENHANCEMENT IN SPATIAL DOMAIN 9

Background, some Basic Grey Level Transformation:- Image Negatives, Log negatives, Piecewise – Linear Transformation Functions:- Contrast stretching, Grey level Slicing, Bit Plane Slicing, Histogram processing: - Histogram Equalization, Histogram Specification, Local Enhancement.

UNIT III IMAGE ENHANCEMENT IN FREQUENCY DOMAIN 9

Two dimensional DFT and its Inverse, Filtering the frequency domain, Basics of filtering in frequency domain, smoothing and sharpening filters. Color Image Processing:- Color Fundamentals and Color Models.

UNIT IV IMAGE COMPRESSION 9

Fundamentals, Coding Redundancy, Interpixel Redundancy Psycho-Visual Redundancy, Image Compression Models, Error Free Compression, Variable – Length Coding, Huffman Coding, Arithmetic Coding, Run-length coding, Lossy Compression, Transform coding, JPEG.

UNIT V IMAGE SEGMENTATION 10

Detection of Discontinuous, Edge linking and Boundary Detection:- Local Processing, Thresholding:- Basic Global Thresholding, Region Based Segmentation:- Region Growing, Region Splitting and Merging, Use of Motion In Segmentation.

TEXTBOOKS:

1. Digital image processing by Rafael C. Gonzale Z, Richard E.Words, Pearson Education, Asia,3rd Edition, 2008.

REFERENCES

1. Fundamental of Digital Image Processing by Anil. K. Jain, Prentice Hall of India Publishing Ltd., New Delhi, 2002. 7th Edition

COURSE OUTCOMES (COs)	
CO1	To learn Fundamentals of Digital Images and the ways to represent it
CO2	To learns the various ways of representing image enhancement in spatial domain
CO3	To learn the concept of image enhancement in frequency domain
CO4	To study about the image compression techniques
CO5	To learn the various methods to specify image boundaries

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							
	CO2	L				H							
	CO3				M	H							
	CO4	L			M	H							
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

	RAPID PROTOTYPING	L	T	P	C
U18PEMT052	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Computer Integrated Manufacturing				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about prototyping principles and tools used for prototyping and to learn about the applications of rapid prototyping				

UNIT I INTRODUCTION TO RAPID PROTOTYPING 7

Introduction: Need for time compression in product development, Product development- conceptual design – development- detail design-prototype- tooling.

UNIT II RP SYSTEMS CLASSIFICATIONS 9

Classification of RP systems, Stereo lithography systems- Principle- process parameters-process details-machine details, Applications.

Direct Metal Laser Sintering (DMLS) system - Principle process parameters process details-machine details, Applications.

UNIT III RP SYSTEM MANUFACTURING TECHNIQUES 9

Fusion Deposition Modeling - Principle- process parameters-process details-machine details, Applications.Laminated Object Manufacturing - Principle process parameters process details machine details, Applications.

UNIT IV DESIGN 3-DIMENSIONAL PRINTERS 10

Solid Ground Curing - Principle- process parameters-process details-machine details, Applications.3-Dimensional Printers - Principle- process parameters-process details-machine details, Applications, and other Concept Modelers like Thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

UNIT V APPLICATIONS OF RP SYSTEMS 10

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM)-Principle. Introduction to rapid tooling and rapid manufacturing, software for RP- STL files, Magics, Mimics Application of Rapid prototyping in Medical field.

TEXTBOOKS:

1. Pham D.T & Dimov.S.S, Rapid manufacturing, Springer-Verlag, London, 2001
2. **C. K. Chua ,K.F. Leong , C.S. Lim, Rapid Prototyping: Principles and Applications (Book & CD Rom),3rd edition, 16 Dec 2008**

REFERENCES

1. Terry Wohlers, Wohlers Report 2000, Wohlers Assosiates, USA, 2000.
2. M. Adithan ,Rapid Prototyping,2015

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of product development
CO2	To learn about the various types of RP systems and their applications
CO3	To study about the different types of RP modeling systems and their applications
CO4	To understand the types of solid curing process and its applications
CO5	To learn about the different types 3-Dimensional Printers and their applications

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1			H			M						
	CO2			H		H				M	H	H	
	CO3		M		H	H		H					
	CO4	M	H			M	H					H	
	CO5	L						H	H	M		H	
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT053	**INTERNET OF THINGS FOR MECHATRONICS**	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Problem Solving and Python Programming				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics of Internet of Things , To understand different applications of Internet of Things ,To understand the fundamental aspects of IoT.				

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Definitions and Functional Requirements –Motivation – Architecture - IoT architecture and platforms - IoT Devices vs. Computers - Trends in the Adoption of IoT - Societal Benefits of IoT - IoT Information Security - Embedded Systems.

UNIT II SENSORS IN IOT 10

Sensing methods - Sensors types – Active, Passive sensors – Environmental sensing methods. Sensor Fusion - Evolving Sensor Technologies - Leveraging Sensor Fusion for the IoT - IoT Sensor Manufacturers - IoT Sensor Data Platforms.

UNIT III INTERFACING METHODOLOGIES 8

Basics of Controllers - Interfacing methodologies - Controllers selection – GPIO interfaces – SPI interfaces – I2C interfaces – RTC interfaces – IDE usage – Bootloader – Memory utilization (EEPROM /Flash). Basic programing of controllers – Controllers Expansion boards (breakouts).

UNIT IV HARDWARE & SOFTWARE PLATFORMS **9**

Hardware Platforms - Intel Galileo, Edison, Arduino, Beaglebone Black & Raspberry Pi.
Software Platforms - Intel XDK, Node-RED, VISUINO, Fritzing, 123dCircuits, Scratch

UNIT V APPLICATIONS OF IoT 9

Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

TEXT BOOK

1.Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012

REFERENCES

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.
3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

COURSE OUTCOMES (COs)	
CO1	To Introduce The Introduction to Internet of Things
CO2	To Explain the Sensors in IoT
CO3	To explain the Interfacing Methodologies
CO4	To explain the Hardware & Software platforms
CO5	To explain the applications of IoT

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	H
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			M
	CO4				M	H		M			M	L	

	CO5		H		M	H		M	H	L	M	M	L
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PEMT054	**VETRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite –				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce all types of Vetronics and their applications in Engineering.				

UNIT I FUNDAMENTALS OF VEHICLE ENGINEERING 6

Engine – Types – Modern Engines –Advanced GDI, Turbo-charged engines transmissions, Chassis systems – Need for Avionics in Civil and Military aircraft and Space systems

UNIT II AUTOMOTIVE ENGINE CONTROL, MONITORING AND DIOGNASTICS SYSTEMS 9

Components of Electronic Engine Management– Engine control functions, Engine control modes, Fuel delivery systems, MPFI, Ignition Systems, Diagnostics – Compression ignition Engines – Emission control Management – Hybrid Power Plants – BAS

UNIT III AUTOMOTIVE TRANSMISSION AND SAFETY SYSTEMS 12

Transmission control – Autonomous cruise control – Braking control, ABS – Traction control, ESP, ASR – Suspension control – Steering control – Stability control– Parking Assist Systems– Safety Systems, SRS, Blind Spot Avoidance – Auto transmission electronic control, Telematics, Automatic Navigation, Future Challenges

UNIT IV AIRCRAFT MECHATRONICS 12

Fundamentals - components of an airplane and their functions - motions of a plane – Inertial Navigation – Sensors - Gyroscope- Principles , Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Direct reading compass, Types of actuation systems-Linear and non-linear actuation system, modeling of actuation systems, Performance testing

equipments for sensors and actuation systems. measurement and control of Pressure , temperature fuel quantity, rpm, torque, engine vibration and power. Electrical Power requirement for Military and Civil standards. Satellite navigation - GPS -system description - basic principles -position and velocity determination

UNIT V MARINE MECHATRONIC SYSTEMS 6

Basics of Marine Engineering – Marine Propulsion Mechatronics elements in ships, submarines, Variable Buoyancy Systems

TOTAL NO .OF PERIODS: 45

REFERENCES

1. William B.Ribbens, "Understanding Automotive Electronics – 7th Edition, Butterworth, Heinemann Wobum, 2004..

2. Robert N Brady, Automotive Computers and Digital Instrumentation, Areston Book Prentice Hall, Eagle Wood Cliffs, New Jersey, 2000..

3. R.K. Jurgen, Automotive Electronics Handbook, McGraw Hill 2nd Edition. 2000

4. Collinson R.P.G. 'Introduction to Avionics', Chapman and Hall, 2002

5. Pallet, E.H.J. 'Aircraft Instruments & Integrated systems', McGraw-Hill, 2002

6. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley& Sons, 2000

7. Pallett, E.H.J. 'Aircraft instruments, principles and applications', Pitman publishing Ltd., London, 1995

COURSE OUTCOMES (COs)	
CO1	To learn the basics of fundamentals of vehicle engineering
CO2	To study about the automotive engine control, monitoring and diognastics systems
CO3	To learn about the basic automotive transmission and safety systems
CO4	To study about The Aircraft Mechatronics
CO5	To learn about Marine Mechatronics Systems

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							H
	CO2	M			M	H							

	CO3				M	H							M
	CO4				M	H							
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

PROFESSIONAL ELECTIVE-VI

U18PEMT061	**EMBEDDED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Electron Devices & Circuits				
	Course Designed by – Dept of Electronics and communication Engineering				
OBJECTIVES	To study embedded hardware and embedded microcomputer systems				

UNIT I REVIEW OF EMBEDDED HARDWARE 9

Gates – Timing diagram – Memory – Microprocessors Buses – Direct Memory Access – Interrupts – Built-in functions on the Microprocessor – Conventions used on Schematic – schematic. Interrupts Microprocessor Architecture – Interrupt basics – Shared data Problem – Interrupt latency.

UNIT II MICROCHIP PIC MICRO CONTROLLER 9

Introduction, CPU Architecture – Registers – Instruction sets addressing modes – Loop timing – Timers – Interrupts, Interrupt timing, I/O Expansion, I^2C Bus Operation Serial EEPROM, Analog to Digital converter, UART – Baud Rate – Data Handling – Initialization, special features- Serial Programming – Parallel Slave Port.

UNIT III EMBEDDED MICROCOMPUTER SYSTEMS 9

Motorola MC68H11 Family Architecture, Registers, Addressing modes Programs, Interfacing methods parallel I/O interface, parallel port interfaces, Memory Interfacing, High Speed I/O Interfacing, Interrupts – Interrupt service routine – Features of interrupts – Interrupt vector and Priority, Timing Generation and Measurements, Input capture, Output compare, frequency Measurement, Serial I/O devices RS 232, RS485.

UNIT IV SOFTWARE DEVELOPMENT 9

Round Robin, Round robin with Interrupts, function – Queue – Scheduling Architecture, Algorithms. Introduction to – Assembler – Compiler – Cross Compilers and Integrated Development Environment (IDE) Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

UNIT V REAL TIME OPERATING SYSTEMS 9

Task and Task States, Tasks and Data, Semaphores and Shared Data Operating System services – Message Queues – Timer function – Events – Memory Management, Interrupt Routines in an RTOS environment, Basic design using RTOS.

TEXT BOOKS :

1. Jonarthan W. Valvano "Embedded Microcomputer Systems", Real Time Interfacing", Thomson learning, 2001.3rd Edition.

REFERENCES :

1. David E. Simon, "An Embedded Software Primer", Pearson Education Asia, 2001.
2. John B Pitman, "Design with PIC Micro controllers", Pearson Education Asia, 1998.
3. Burns, Alan and Wellings, "Real – Time Systems and Programming Languages", second edition. Harlow: Addison Wesley – Longman, 1997.
4. Grehan Moore and Cyliax, "Real Time Programming: A guide to 32 bit Embedded Development", Addison Wesley – Longman, 1998.
5. Heath Steve, "Embedded Systems Design", Newnes, 1997.2nd Edition.

COURSE OUTCOMES (COs)	
CO1	To learn review of embedded hardware
CO2	To learn about microchip PIC micro controller
CO3	To learn embedded microcomputer systems
CO4	To learn about software development
CO5	To understand the real time operating systems

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	

	CO5							H	H			H	
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT062	TOTAL QUALITY MANAGEMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Designed by – Dept of Mechanical Engineering				

OBJECTIVES

1. To introduce to the student about the basic terms related to quality and concepts of quality management
2. To familiarize the student about the basic principles of total quality management
3. To acquaint the student with the basic statistical tools used in process control
4. To introduce to the student about the various tools used in implementing and checking total quality management
5. To familiarize the student about the different quality systems used in auditing the quality of a company/industry/organization

UNIT I **9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – AnalysisTechniques for Quality Costs, Basic concepts of Total Quality Management, HistoricalReview, Principles of TQM, Leadership – Concepts, Role of Senior Management,Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers toTQM Implementation.

UNIT II 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, ServiceQuality, Customer Retention, Employee Involvement – Motivation, Empowerment,Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership –Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development,Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III **9**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendencyand Dispersion, Population and Sample, Normal Curve, Control Charts for variables andattributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV **9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality FunctionDeployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality LossFunction, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA –Stages of FMEA.

UNIT V **9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System –Elements, Implementation of Quality System, Documentation, Quality Auditing, TS16949, ISO 14000 – Concept, Requirements and Benefits

TEXT BOOKS:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc.2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCE BOOKS:

1. Evans. J. R. & Lindsay. W,M "The Management and Control of Quality", (5th Edition),South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford,1989.
4. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks",New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.
6. freecomputerbooks.com/**Total-Quality-Management**-and-Six-Sigma.htm

COURSE OUTCOMES (COs)	
CO1	By understanding about various quality terms, it will be helpful for the student to maintain quality in his/her organization
CO2	The student will be able to formulate new plans/procedures to be implemented to achieve the desired quality status by knowing about the various principles of quality management
CO3	The student will be able to analyze the periodical data in quality control using statistical

	tools
CO4	The total quality management tools will help the student to understand the procedures in measuring the quality of the organization/process and will also enable him/her to identify the parameters that are improving/depriving the quality
CO5	By knowing about the quality ISO systems, the student will be maintain processes/documentation properly so that the quality maintained by his/her organization gets recognized

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	
	CO5							H	H			H	
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT063	MICRO ELECTRONICS AND NANO ELECTRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics Engineering & Basics Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various concepts about the micro electronics and nano electronics				

UNIT-I SEMICONDUCTOR PHYSICS 9

Introduction to semiconductor physics: Review of quantum mechanics, electrons in periodic lattices, E-k diagrams, Quasi-particles in semiconductors, electrons, holes and phonons. Boltzmann transport equation and solution in the presence of low electric and magnetic fields - mobility and diffusivity; carrier statistics; continuity equation, poisson's equation and their solution; high field effects: velocity saturation, hot carriers, avalanche breakdown, punch through and kirk effects.

UNIT-II SEMICONDUCTOR JUNCTIONS 9

Semiconductor junctions: Schottky, homo- and hetero-junction band diagrams and I-V characteristics, small signal switching models; two terminal and surface states devices based on semiconductor junctions. Bipolar transistor working, its charge control, and gummel poon model, structure of graded base, graded emitter transistor, hetro junction transistor.

UNIT-III MOS STRUCTURES 9

MOS structures: Semiconductor surfaces; the ideal and non ideal MOS capacitor band diagrams and CVs; Effects of oxide charges, defects and interface states; characterization of MOS capacitors: HF and LF CVs, avalanche injection; high field effects and breakdown. Long & short channel effects.

NANOELECTRONICS

UNIT-IV MOSFET 9

Shrink-down approaches: Introduction, CMOS scaling, the nanoscale MOSFET, finfets, vertical. MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), resonant tunneling transistors, single electron transistors, new storage, optoelectronic, and spintronics devices.

UNIT-V CARBON NANOTUBE ELECTRONS 9

Atoms-up approaches: Molecular electronics involving single molecules as electronic devices, transport in molecular structures, molecular systems as alternatives to conventional electronics, molecular interconnects; Carbon nanotube electronics, bandstructure& transport, devices, mems applications.

TEXTBOOKS:

1. Millman and Grabel, “Microelectronics”, 2nd Ed. Tata McGraw-Hill (2004).
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

REFERENCE:

1. Sedra A S and Smith K C, “Microelectronic Circuits” 4th Ed., New York, Oxford University Press, New York (1997).
2. Tocci R J and Widmer N S, “Digital Systems – Principles and Applications”, 10th Ed., Pearson Education India, New Delhi (2001).
3. Cooper and Helfrick, “Modern Electronic Instrumentation and Measuring Techniques”, 4th print Prentice Hall of India, New Delhi (1996).
4. Boylestad and Nashelsky, “Electronic Devices and Circuit Theory”, 8th Ed, Pearson Education India, New Delhi (2002).

5. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, 3rd Ed. 2003.
6. A.Nabok, "Organic and Inorganic Nanostructures", Artech House, 2000.
7. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.

COURSE OUTCOMES (COs)	
CO1	To introduce the semiconductor physics and quantum electronics
CO2	To explain the different types of junctions
CO3	To explain the MOS structure
CO4	To introduce and explain the nano electronics and its structure
CO5	To understand the concept of various application of micro electronics& Nano electronics

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M			H							
	CO2				M	H	M	L					M
	CO3				M	H							
	CO4				M	H							
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT064	**COMPUTER INTEGRATED MANUFACTURING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – CNC Technology, Manufacturing Technology				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To understand the various concepts of CAD,CAM and Computer Integrated Manufacturing				

UNIT I INTRODUCTION TO CAD AND ITS ELEMENTS 9

Principles of Computer hardware, Software and Operating System, application Programs, Data Handling and File Structures, Computer aid in Phases of design- Development of Design Database using CAD Systems- Conceptual Design Process Analysis Optimization- Detailed Design and Documentation.

UNIT II ELEMENTS OF CAD SYSTEMS AND DESIGN USING COMPUTERS 9

Elements of CAD Systems, Introduction to Graphic Hardware, Software, Details of 2D Software Packages-Layering, Drawing Primitives, Display Techniques, Editing, utilities, Scaling, Dimensioning, 3D Visualization, Geometric Modeling-Wireframe and Solid models.

UNIT III DESIGN USING COMPUTERS 9

Design of Gears, Couplings, Flywheels, Shafts Connecting Rods etc. Software for Vibration Problems Stress Analysis, Kinematic Analysis, Dynamic Analysis.

UNIT IV COMPUTER AIDED MANUFACTURING 9

Numerical Control- Modes- NC Elements- NC Machine Tools- CNC Machines- CNC Hardware Basics- CNC Tooling- CNC Machine Tools and Control System- Part Programming- Manual and Computer Aided- Turning Center Programming- Advanced Part Programming- Direct Numerical Control- Adaptive Control- Computer Aided Part Programming, APT, Introduction to Robotics, Group Technology, Computer Aided Process Planning, FMS.

UNIT V COMPUTER INTEGRATED MANUFACTURING 9

CIM as a Concept and a Technology- CASA/SME Model of CIM-Benefits- Communication Matrix in CIM- Fundamentals of Computer Communication n CIM, CIM Data Transmission Method, Serial , parallel, asynchronous, modulation, Demodulation, Simplex and Duplex- Types of Communications in CIM- Point to Point, Star and Multiplexing- CIM for Batch Production- Group Technology – FMS- Process Control in CIM- Characteristics of Manufacturing Process Data- Continuous, Analog, Discrete Binary and Pulse Data- ADC/DC Multiplexers, Process Monitoring Through Computer- Types of Computer Process Control- Preplanned, Direct Digital Control (DDC)- Regular Control and Feed Forward Control, Requirements of Control Programming Interrupt, Real Time Clock Input.

TEXT BOOK:

1. Radhakrishnan P. CAD/CAM/CIM, 3rd Edition, New central Book Agency, 2008.

REFERENCES

1. Rao P.N. CAD/CAM, Principles and Application, Tata McGraw Hill, 2005.2nd Edition.
2. Mikell P.Groover, Automation, Production Systems and CIM, 4th Edition, Prentice Hall of India,2001.
3. Chris McMahon and Jimmy Browne, CAD/CAM, Pearson Education, 2001.2nd Edition.

COURSE OUTCOMES (COs)	
CO1	To introduce the CAD and its element.
CO2	To explain the elements of cad systems and design using computers.
CO3	To explain the various component design using computer.
CO4	To explain the computer aided manufacturing.
CO5	To explain the computer integrated manufacturing.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H						L	
	CO2	M			M	H		M					
	CO3				M	H							
	CO4				M	H			M				
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47th Meeting of Academic Council, July, 2018											

OPEN ELECTIVES

U18OEMT001	**MEMS & NANOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various concepts about the micro electronics mechanical system and Nano technology				

UNIT I INTRODUCTION TO MICRO SENSORS 9

Introduction: Historical background development of microelectronics, evolution of micro sensors, MEMS, emergence of micro machines.

Micro sensors: Introduction, thermal sensors, mechanical sensors, flow sensors and Introduction to SAW devices

UNIT II MEMS MANUFACTURING TECHNIQUES 9

MEMS materials and processing: Overview, metals, semiconductors, ceramic, polymeric and composite materials.

Microstereolithography: Introduction, Scanning Method, Projection Method, Applications. LIGA Process: Introduction, Basic Process and Application.

UNIT III MEMS FABRICATION TECHNIQUES 9

Micro System Fabrication Processes: Photolithography, Chemical Vapor Deposition, Etching, Bulk and Surface Micro Manufacturing

UNIT IV INTRODUCTION TO NANOTECHNOLOGY 9

Introduction to Nanotechnology: The nanoscale. Consequences of the nanoscale for technology and society. - Technologies for the Nanoscale, Top-down versus bottom-up assembly. Visualisation, manipulation and characterisation at the nanoscale, Proximal probe technologies. Self-assembly.

UNIT V NANOSCALE MANUFACTURING 9

Nanoscale Manufacturing: Nanomanipulation, Nanolithography - An introduction to tribology and its industrial applications - Nanoscale Materials and Structure, Nanocomposites, Safety issues with nanoscale powders - Applications, Applications in energy, informatics, medicine, etc

TEXTBOOKS:

1. **Mark Ratner & Daniel Ratner, Nano Technology, Pearson Education,2003.**
2. Tai – Ran Hsu, " MEMS & MICROSYSTEMS Design and Manufacturing", TATA McGRAW-HILL, 2002
3. S.M. Sze, Semiconductor Sensors, John Wiley & Sons, INC., 1994.

REFERENCE:

1. Marc J. Madou, "Fundamentals of Microfabrication", II Edition, CRC Press, 2002.
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press, 2002
3. M.Elwenspoek, R.Wiegerink, Mechanical Microsensors, Springer-Verlag Berlin Heidelberg, 2001.
4. David Ferry, Transport in Nanostructures, Cambridge University Press, 2000.2nd Edition.
5. S.Datta,Electron Transport in Mesoscopic Systems, Cambridge University Press, 1995.

COURSE OUTCOMES (COs)	
CO1	To introduce various micro sensors and emergence of micro machines.
CO2	To study about various materials for micro and Nano fabrication
CO3	To know various micro fabrication methods.
CO4	To understand the concept of Nano scale and technology
CO5	To learn Nano scale manufacturing

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H	L						
	CO2				M	H	L						

	CO3				M	H	L						H
	CO4				M	H	L						
	CO5				M	H	L						
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18OEMT002	**NON-DESTRUCTIVETESTING**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite –Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce all types of NDT and their applications in Engineering.				

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications

of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002

2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.

3. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002

4. www.ndt.net

COURSE OUTCOMES (COs)	
CO1	To learn the basics of various non-destructive methods
CO2	To study about the Eddy Current Testing & Acoustic Emission
CO3	To learn about the basic Magnetic Particle Testing & Thermography
CO4	To study about The Ultrasonic Testing
CO5	To learn about t111.8485he Radiography

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							H
	CO2	M			M	H							
	CO3				M	H							M

	CO4				M	H							
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

	BIO-MECHATRONICS	**L**	**T**	**P**	**C**
U18OEMT003	Total Contact Hours -45	3	0	0	3
	Prerequisite –Basic Electronics, Sensors Basics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To know the principle, design and applications of various flow measurement assisted device for the human functional system				

UNIT I BIO MECHANICS AND SIGNAL PROCESSING 9

Cardiovascular biomechanics, Musculoskeletal and orthopedic biomechanics, human ergonomic, Rehabilitation. Bio-medical signals, Signal acquisition and signal processing-Isolation barriers, Bio-Image processing

UNIT II BIO SENSORS AND ACTUATORS 9

Introduction to Bio mechatronics, Electrodes - Types, - Measurement of blood pressure - Blood Gas analyzers: pH of blood, Smart actuators for biological applications

UNIT III MEDICAL MEASUREMENTS 9

Heart rate-Heart Sound-Pulmonary Function Measurements –Spirometer-Finger tip oximeter-ESR,GSR Measurements

UNIT IV SENSORY ASSIST DEVICES 9

Hearing aids-implants-Optical Prosthetics,Visual Neuroprosthesis-Sonar based Systems,Respiratory aids,Tactile devices for visually challenged

UNIT V ACTIVE AND PASSIVE PROSTHETIC LIMBS 9

Introduction to prosthetics, Passive Prosthetics-Walking Dynamics, Knee and Foot Prothesis, Active Prosthesis-Control of Prostheic arms and hands, Leg Mechanisms, Ankel-Foot Mechanisms, Prosthesis Suspension

TEXTBOOKS

1. Graham M. Brooker, "Introduction to Bio-Mechatronics", Sci Tech Publishing, 2012.

REFERENCES

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Bio-Medical Instrumentation and Measurements", II edition, Pearson Education, 2009
2. Raymond Tong Kaiyu . "Bio-mechatronics in Medicine and Healthcare" Pan Stanford Publishing, CRC Press, 2011.

COURSE OUTCOMES (COs)	
CO1	To understand the basics of bio mechanics
CO2	To have adequate knowledge on sensors and actuator
CO3	To study about the medical instruments
CO4	To learn about the sensory assist devices
CO5	To know the concepts of active and passive prosthetic limbs

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H		M					
	CO2	M			M	H				H			
	CO3				M	H		M					
	CO4				M	H	H		L				
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18OEMT004	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Robotic and Machine Vision				
	Course Designed by – Department of Mechatronics Engineering				
OBJECTIVES	To introduce the various concepts about the Artificial Intelligence				

UNIT I INTRODUCTION **9**

Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems – searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.

UNIT II PRINCIPLES OF DECISION-MAKING **9**

Crisp and Fuzzy Logic-Decision Trees-Case-based Reasoning-Bayesian Belief Networks-Path Planning-Voronoi Diagrams

UNIT III SEARCHING TECHNIQUES **9**

Motion Planning-Compute Cost-Optimal Path-First Search Program-Expansion Grid-Dynamic Programming-Computing Value-Optimal Policy-Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision

UNIT IV NEURAL NETWORKS AND EXPERT SYSTEMS **9**

Evaluation and Search-Genetic Algorithms-Simulated Annealing-Particle Swarm Optimization-Neural Networks-Static Networks-Associative Networks-Cerebellar Model Articulation Controller-Expert Systems-Production Systems-Forward Chaining-Backward Chaining

UNIT V SLAM (Simultaneous Localization and Mapping) **9**

Localization-Planning-Fun with Parameters-SLAM-Graph SLAM-Implementing Constraints-Adding Landmarks-Matrix Modification-Untouched Fields-Landmark Position-Confident Measurements-Implementing SLAM

TOTAL: 45

TEXT BOOKS

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 2nd Edition, Pearson Education / Prentice Hall of India, 2004.

2. Donald A.Waterman, ‘A Guide to Expert Systems’, Pearson Education.

Reference Books

1. Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd., 2000.

2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.

3. George F. Luger, "Artificial Intelligence-Structures And Strategies For Complex Problem Solving", Pearson Education / PHI, 2002**.**

4. Janakiraman, K. Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.

5. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003

COURSE OUTCOMES (COs)													
CO1	To learn pattern recognition												
CO2	To learn about game playing												
CO3	To learn knowledge representation												
CO4	To learn about knowledge representation using other logic												
CO5	To learn structural representation of knowledge												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M			H							
	CO2				M	H	L				M		
	CO3				M	H							
	CO4				M	H	M	H			M		
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											