M. ARCH (GENERAL) – FULL TIME
CHOICE BASED CREDIT SYSTEM I TO IV SEMESTERS
CURRICULA & SYLLABI

M - ARCH GENERAL (SEMESTER I)						
SL. NO.	COURSE CODE	COURSE TITLE	L	T	P/S	C
THEORY						
1	P18PCAR101	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGNI	3	0	0	3
2	P18PCAR102	URBAN CONSERVATION AND PRACTICE	2	0	2	3
3	P18PCAR103	TRADITIONAL AND CONTEMPORARYLANDSACPES	3	0	0	3
4	P18PEAR104	SUSTAINABLE AND GREEN BUILDING DESIGN	2	0	6	4
STUDIO						
1	P18PCAR1L1	URBAN DESIGN STUDIO	2	0	6	6
TOTAL			12	0	14	19

M - ARCH GENERAL (SEMESTER II)						
SL. NO.	COURSE CODE	COURSE TITLE	L	T	P/S	C
THEORY						
1	P18PCAR201	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN II	3	0	0	3
2	P18PCAR202	PERFORMANCE EVALUATION IN BUILDINGS	2	0	2	3
3	P18PCAR203	SERVICES IN HIGH RISE BUILDINGS	3	0	0	3
4	P18PEAR 001	PROFESSIONAL ELECTIVE-I	3	0	0	3
5	P18PEAR 002	PROFESSIONAL ELECTIVE-II	3	0	0	3
STUDIO						
1	P18PCAR2L1	ADVANCED ARCHITECTURAL DESIGN STUDIO I	0	0	12	6
TOTAL			14	0	14	21

M - ARCH GENERAL (SEMESTER III)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/S**	**C**
THEORY						
1	**P18PCAR301**	**EMERGING PRACTICES IN HOUSING**	**2**	**0**	**2**	**3**
2	**P18PCAR302**	**RESEARCH METHODOLOGIES IN ARCHITECTURE**	**3**	**0**	**0**	**3**
4	**P18PEAR 007**	**PROFESSIONAL ELECTIVE-III**	**3**	**0**	**0**	**3**
5	**P18PEAR 009**	**PROFESSIONAL ELECTIVE-IV**	**3**	**0**	**0**	**3**
STUDIO						
1	**P18PCAR3L1**	**ADVANCED ARCHITECTURAL DESIGN STUDIO II**	**0**	**0**	**12**	**6**
2	**P18PCAR3L2**	**DISSERTATION**	**0**	**0**	**6**	**3**
TOTAL			**11**	**0**	**20**	**21**

M - ARCH GENERAL (SEMESTER IV)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/S**	**C**
STUDIO						
1	**P18PCAR4L1**	**THESIS**	**0**	**0**	**22**	**11**
2	**P18PCAR4L2**	**BUILDING INFORMATION MODELLING**	**0**	**0**	**6**	**3**
TOTAL			**0**	**0**	**28**	**14**

LIST OF ELECTIVES - M. ARCH (GENERAL)

S. NO.	COURSE CODE	COURSE TITLE	TYPE	L	T	P/S	C
1	P18PEAR001	BUILDING MANAGEMENT AND CONTROL SYSTEMS	PE	3	0	0	3
2	P18PEAR002	APPROPRIATE TECHNOLOGIES AND SUSTAINABLE CONSTRUCTION	PE	3	0	0	3
3	P18PEAR003	ARCHITECTURE AND CRITICAL THEORY	PE	3	0	0	3
4	P18PEAR004	GIS MODELLING IN URBAN PLANNING	PE	3	0	0	3
5	P18PEAR005	ANTHROPOLOGY AND ARCHITECTURE	PE	3	0	0	3
6	P18PEAR006	MATERIAL CONSERVATION	PE	3	0	0	3
7	P18PEAR007	URBAN LANDSCAPE DESIGN	PE	3	0	0	3
8	P18PEAR008	LANDSCAPE ECOLOGY AND PLANNING	PE	0	0	6	3
9	P18PEAR009	WEB DESIGN AND PORTFOLIO PRODUCTION	PE	3	0	0	3
10	P18PEAR010	SUSTAINABILITY AND ENERGY CONSERVATION IN LANDSCAPE ARCHITECTURE	PE	3	0	0	3
TOTAL				**27**		**6**	**30**

L- Lecture **T**- Tutorial **P**- Practical **S**- Studio **C**- Credits

PROFESSIONAL CORE COURSES (PC)

Sl. No.	Course Code	Course title	Category	Contact periods	L	T	P	C
1.	P18PCAR101	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGNI	PC	3	**3**	**0**	**0**	**3**
2	P18PCAR102	URBAN CONSERVATION AND PRACTICE	PC	3	**2**	**0**	**2**	**3**
3	P18PCAR103	TRADITIONAL AND CONTEMPORARYLANDSACPE	PC	3	3	0	0	3
4.	P18PEAR104	SUSTAINABLE AND GREEN BUILDING DESIGN	PC	3	2	0	6	4
5	P18PCAR1L1	URBAN DESIGN STUDIO	PC	8	2	0	6	6
6.	P18PCAR201	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN II	PC	3	3	0	0	3
7	P18PCAR203	SERVICES IN HIGH RISE BUILDINGS	PC	3	3	0	0	3
8	P18PCAR2L1	ADVANCED ARCHITECTURAL DESIGN STUDIO I	PC	6	0	0	12	6
9	P18PCAR301	EMERGING PRACTICES IN HOUSING	PC	3	2	0	2	3
10	P18PCAR302	RESEARCH METHODOLOGIES IN ARCHITECTURE	PC	3	3	0	0	3
11	P18PCAR3L1	ADVANCED ARCHITECTURAL DESIGN STUDIO II	PC	8	0	0	6	3
12	P18PCAR4L1	THESIS	PC	12	0	0	22	11

PROFESSIONAL ABILITY ENHANCEMENT COURSES (PAEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	P18PCAR202	PERFORMANCE EVALUATION IN BUILDINGS	PAEC	3	2	0	2	3
2.	P18PCAR4L2	BUILDING INFORMATION MODELLING	PAEC	6	0	0	6	3
3.	P18PCAR3L2	DISSERTATION	PAEC	6	0	0	6	6

M. ARCH (G) I TO IV SEMESTERS OFCURRICULA AND SYLLABI

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR101	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN I	3	0	0	3

OBJECTIVES:

- To investigate the contemporary theories of media and their influence on the perception of space andarchitecture.
- To provide an overview of various contemporary design processes and its relation tocomputation.

UNIT I	INTRODUCTION	6

Investigation of contemporary theories of media and their influence on the perception of space and architecture.Technology and Art – Technology and Architecture – Technology as Rhetori – Digital Technology and Architecture.

UNIT II	ASPECT OF DIGITAL ARCHITECTURE	9

Aspects of Digital Architecture – Design and Computation – Difference between Digital Process and Non-Digital Process – Architecture and Cyber Space – Qualities of the new space – Issues of Aesthetics and Authorship of Design – Increased Automatism and its influence on Architectural Form and Space.

UNIT III	CONTEMPORARY PROCESS	12

Overview of various Contemporary design process and it relation to computation: Diagrams – Diagrammatic Reasoning – Diagrams and Design Process – Animation and Design – Digital Hybrid Design Protocols – Concept of Emergence - Introduction to Cellular Automata and Architectural applications – Genetic algorithms and DesignComputation

UNIT IV	GEOMETRIES AND SURFACES	12

Fractal Geometry and their properties – Architectural applications - Works of ZviHecker–- Shape Grammar - Shapes, rules and Label - Shape Grammar as analytical and synthetic tools- Combining Shape grammar and Genetic algorithm to optimize architectural solutions - Hyper Surface– Introduction to Hyper surface and concepts of Liquidarchitecture.

UNIT V	CASE STUDIES	6

Case studies- Study, understanding and analysis of known examples at the national and international levels which demonstrates the contemporary theories of media and their influence on the perception of space and architecture, contemporary design processes and its relation to computation.

REFERENCES:

1. Peter Eisenmann, Diagram: An Original Scene of Writing, DiagramDiaries
2. MOVE, UNStudio
3. Grey Lynn, The Folded, The Pliant and The Supple, Animateform
4. Contemporary Techniques in Architecture, Halsted Press,2002
5. Ali Rahim, Contemporary Process in Architecture, John Wiley & Sons,2000
6. Walter Benjamin, Practices of Art in the Age of Mechanical Reproduction Colin press,1977
7. Work of Architecture in the Age of Mechanical Reproduction, Differences MIT press,1997.
8. William J Mitchell, the Logic of Architecture: Design, Computation and Cognition. MIT Press, Cambridge,1995
9. Marcos Novak, invisible Architecture: An Installation for the Greek Pavilion, Venice Biennale,2000.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understanding of the effect of contemporary theories of media on contemporary architectural design.
CO2	Understanding of various contemporary design process and their relation to computation
CO3	Analyse the new concepts of contemporary architecture which are the result of changing Parameters of technology.
CO4	To Evaluate the concepts of contemporary architecture in ration with ecology urbanization, social patterns, etc.
CO5	To Design with all the terms and terminology of contemporary architecture.
C06	To ApplyEffect of technology on 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		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	6th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR102	URBAN CONSERVATION AND PRACTICE	2	0	2	3

OBJECTIVES:

- To introduce to the students the idea of conservation as enhancing quality of life, as effective planning strategy, as means of particularization of place and as a way to address issues of memory andidentity.
- To introduce the students to issues and practices of urban conservation at various levels and scales.
- To give an overview of current status of conservation inIndia.

UNIT I	INTRODUCTION TO CONSERVATION	15

Understanding Heritage.Types of Heritage.Heritage conservation – Need, Debate and purpose. Defining Conservation, Preservation and Adaptive reuse. Distinction between Architectural and Urban Conservation. International agencies like ICCROM, UNESCO AND their rolein Conservation.

UNIT II	CONSERVATION IN INDIA	15

Museum conservation – monument conservation and the role of Archeological Survey of India – role of INTACH – Central and state government policies and legislations – inventories and projects – select case studies – craft Issues of conservation –conservation project management.

UNIT III	CONSERVATION PRACTICE	15

Listingofmonuments–documentationofhistoricstructures–assessingarchitectural character – historic report – guidelines for preservation, rehabilitation and adaptive re-use of historic structures – seismic retrofit and disabled access /services additions to historic buildings – heritage sitemanagement.

UNIT IV	URBAN CONSERVATION	15

Over view of urban history of India and Tamil Nadu – understanding the character and issues of historic cities – select case studies of sites like Thanjavur, Kumbakonam, Kanchipuram, Chettinad – historic districts and heritage precincts.

UNIT V	CONSERVATION AND URBAN PLANNING	15

Norms for conservation of heritage buildings and sites as part of Development Regulations - Conservation as a planning tool – financial incentives and planning tools such as TDR,
(transferable development right) – Urban conservation and heritage tourism.

TOTAL :60 PERIODS

REFERENCES:

1. Donald Appleyard, The Conservation of European Cities, M.I.T. Press, Massachusetts.
2. James M. Fitch, Historic Preservation: Curatorial Management of the Built World by
1. University
2. Press of Virginia; Reprint edition (April 1, 1990)
3. A Richer Heritage: Historic Preservation in the Twenty – First Century by Robert E. Stipe.
4. Conservation Manual, BernardFielden
5. Bernard Feilden, Conservation of Historic Buildings, 2nd Edition, Butterworth, 1994.
6. B.K. Singh, State and Culture, Oxford, NewDelhi.
7. A.G.K. Memon ed. Conservation of Immovable Sites, INTACH Publication, N.DelhiSeminar
8. Issue on Urban Conservation. Christropher Brereton, The repair of Historic Buildings. Advice on principles and methods; English Heritage1991.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	An understanding of the need and benefits of urban conservation.
CO2	Sensitised as well as informed to carry forth this understanding in the realm of practice/research
CO3	Enhancing quality of life, as effective planning strategy, as means of particularization of place and as a way to address issues of memory andidentity.
CO4	To analyse the issues and practices of urban conservation at various levels and scales.
CO5	Apply and overview of current status of conservation in India.
C06	Gain knowledge of different methods for assessing architectural values and significance

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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	H		H
	CO2		H		H	H	M		M		L	H	
	CO3	M				L		M		M			H
	CO4		L							M		L	
	CO5	M	L	M	M				L				H
	C06			M			L						
3	Category	Professional Core (PC)											
4	Approval	5th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR103	TRADITIONAL AND CONTEMPORARY LANDSCAPES	3	0	0	3

OBJECTIVES:

- To study the social and cultural influences on traditional landscapes through analysisofformandspace,sitingprinciplesofeachperiodwithexamples.
- To study contemporary landscape and the manifestation in the western and Indiancontext.

UNIT I	EASTERN TRADITIONS AND ISLAMIC LANDSCAPES	15

Early traditions and beliefs about landscape and environment in east.Ancient Indian traditions–Vedic, Jainism, Buddhism and later Hindu movements.Symbolic meanings and sacred value of natural landscapes. Transfer of concepts through Buddhism to China–Chinese landscape development–gardens of China–Pre Buddhist Japanese landscapes–impact of China on Japanese garden–Japanese gardens. Nomadic culture of central Asia–advent of Islam–concept of Paradise as a garden–spreadofIslamictraditionstotheWestandEast.EasternexpressionofIslam –SamarkhandandMughulIndia–Tombandpleasuregarden–Moghulconceptsofsite planning.WesternexpressionofIslam–SpainAlhambraandGenerallife,Granada.

UNIT II	RENNAISSANCE AND THE EVOLUTION OF NEW THOUGHTS	6

Development of the enclosed garden in the Middle ages. Renaissance–Italy, France and England, Romanticism. Influences and linkages across cultures. Study of the western landscapes till the nineteenthcentury.

UNIT III	THE EVOLUTION OF THE MODERN LANDSCAPE	15

Industrialization and urbanization–impacts and development of the concept ofpublic open spaces, open space development in new towns, parks movement. Open space development and its urban design and planning context, Early industrial towns and thegardencitymovement.Publicparkasamajorcomponentofurbanlandscape,the works of F.L.Ohmstead, and other pioneers. Open space development and Close conceptual relationship between Town planning, urban design and landscape architecture.Examples.

UNIT IV	THE MODERN MOVEMENT, CONTEMPORARY CONCEPTS AND CONCERNS	9

Changing concepts of space and the relationship of architecture to landscape.Study of selected works of modern architects and landscape architects.Postwar development in Europe. The influence of Ian Mcharg on Landscape architecture.The works of Jellicoe, Burle Marx and others. Concept of sustainable landscape development, Cultural landscapes their definition, identification,characteristics, policies, Artistic sensibility in landscape architecture and land art, New development in urban Landscapedesign.

UNIT V	INDIAN CONTEXT	6

Issues in contemporary India, Analysis and understanding of philosophies of contemporary landscape works in India, case studies.

TOTAL : 45 PERIODS

REFERENCES :

1. Geoffrey and Susan Jellico, The landscape of Man, Thames & Hudson Publication, 1995
2. Robert Holden, New landscape Design, Lawrence king publishing, UK,2003
3. Penelope Hill, Contemporary history of garden design, Birkhauser publishers, 2004
4. Elizabeth Barlow Rogers, Landscape Design – A Cultural &Architectural History, Hary& Abram inc. publishers,2001.
5. Phillip Pregill & Nancy Volkman, Landscapes in History, Van Nostrandpublishers,1993.
6. Jonas Lehrman, Earthly Paradise- Garden and courtyard in Islam, Thames and Hudson,1980.
7. G.B.Tobey, A history of American Landscape architecture, American elsevier Publishing Co.,NY,1973.
8. Pieluigi Nicholin, Francesco Repishti, Dictionary of today‟s landscape designers, SkiraEditores P.A,2003.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Relationship between culture and Landscape design.
CO2	Perception of open spaces in different cultures.
CO3	To study the social and cultural influences on traditional landscapes through analysis of form and space, siting principles of each period with examples.
CO4	To study contemporary landscape and the manifestation in the western and Indian context.
CO5	Concepts of individuality in visual creations are enriched through the subjects Drawing, Painting and Composition.
CO6	Courses of studies in Sculpture have been planned with emphasis on the creative expression as well as a refinement in a student's development in practical/technical aspects.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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	H			H					M			
	CO3		M				L				L		
	CO4	M			M			H					
	CO5		M			H							L
3	Category	PC											
4	Approval	4th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR104	SUSTAINABLE AND GREEN BUILDING DESIGN	2	0	6	5

OBJECTIVES:

- To sensitize the students to the various aspects of sustainable and green building design in the context of global warming and climatechange
- To study the building material for its impact onenvironment.
- To expose the students to green ratedbuildings.

UNIT I	INTRODUCTION	15

Attitudes to architecture: a historical perspective- General premises and strategies for sustainable and green design- objectives and basis- Eco-mimicry as a design tool based on ecosystem analogy- theoretical basis for a sustainable and eco friendlydesign.

UNIT II	ECO HOUSE	30

The form of the house: the building as an analogy- design from first principles: conserving energy;working with climate: passive solar design; minimizing new resources; respect for users; respect for site and holism-photovoltaics and solar hot water systems; water usage; small scale wind systems and hydro power; Case studies- Studio project on design of eco houses: context specific.

UNIT III	ENVIRONMENTAL IMPACT OF BUILDING MATERIALS	15

Measuring the impact of building materials- calculating embodied energy- recycling and embodied energy- processing and embodied energy- time and embodied energy- embodied energy of different building materials- low energy building and masonry materials- life cycle analysis- Case studies andanalysis.

UNIT IV	GREEN CONSTRUCTION AND ENVIRONMENTAL QUALITY	15

Sustainable architecture and Green Building: definition- Green building Evaluation Systems; LEED Certification; Green Globe Certification; Case studies which look at the environmental approach renewable energy- controlling the water cycle- impact of materials on the environment – optimizing construction-site management- environmental management ofbuildings.

UNIT V	SUSTAINABLE AND GREEN BUILDING DESIGN STUDIO	30

This studio will explore collaborative learning to explore, investigate and apply various parameters of sustainability for design development of projected building/ urban scenarios

TOTAL: 120 PERIODS

REFERENCES:

1. KenYeang;Ecodesign-AManualforEcologicaldesign,Wiley-Academy;2006
2. Sue Roaf et all; Ecohouse: A design Guide; Elsevier Architectural Press;2007
3. Thomas E Glavinich; Green Building Construction; Wiley;2008
4. Brenda and Robert Vale; Green Architecture- Design for a Sustainable Future; Thames and Hudson;1996.
5. Daniel Vallero and Chris Brasier; Sustainable Design- The science of sustainability and Green Engineering; Wiley;2008.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	An understanding on sustainability
CO2	Knowledge on renewable energy and energy conservation through material usage.
CO3	A thorough understanding on designing green buildings.
CO4	To expose the students to green rated buildings.
CO5	Analyze the building material for its impact on environment.
C06	Apply and design in the context of global warming and climate change.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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	H		M
	CO2		H		H	M	M		M		L	L	
	CO3	L				L		M		M			M
	CO4		H							M		L	
	CO5	M	L	H	M				L				M
	C06			M			M						
3	Category	Professional Core (PC)											
4	Approval	8th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR1L1	URBAN DESIGN STUDIO	2	0	6	5

OBJECTIVES:

- To introduce and identify the issues/ aspects of contemporary urban form through study of history of urbanism, contemporary urban theories, urbanism and urban design precedents.
- To intervene through design, addressing the effects of some of these aspects/ issues.

UNIT I	INTRODUCTION	25

Introduction to origin and evolution of cities and urbanism- historic review of the development of the urban design discipline and principles- introduction to various issues and aspects that impinge on the urban condition today such as globalisation, digital revolution, contemporary processes, sustainability, splintering urbanism through changes in information and communication networks and transportation.

UNIT II	READING THE URBAN FABRIC	20

Introductiontodifferentwaysofreadingoftheurbanfabric-waysofinterpretingthe city such as type, phenomenology, etc.,- tools ofmapping.

UNIT III	SUSTAINABLE DEVELOPMENT	25

Sustainable development– Sustainable Cities Program - Revitalization of brown field sites- Transit Metropolis- CaseStudies.

UNIT IV	RESTRUCTURING THE CITY	20

Contemporary Processes in Urban Design- Place making in the Digital Age – reconfiguring public realm – Urbanisation and Excursions on density.

UNIT V	APPLICATION OF DIGITAL TECHNIQUES IN URBAN DESIGN	30

Depiction of Urban Spaces in Digital Media - Role of Digital Media in Reconfiguring Urban Space –Case studies – Application of Geographic Information Systems, diagramming and 3D Modeling tools in Urban Design - Digital Media as a facilitator for participatory, sustainable urbandesign.

TOTAL: 120 PERIODS

REFERENCES :

1. CrigoreBirdea (ed.), Virtual Reality Technology. Wiley and Sons, New York, 1994
2. William J. Mitchell, City of Bits: Space, Place and the infobahn, MIT Press, 1996
3. Charles Correa, Housing and Urbanisation, Thames and Hudson,1999
4. Neil leach, Designing for the digital world, John Wiley and Sons,2002
5. Edmond Bacon, Design of Cities, Penguin1967
6. Christian Norberg Schulz- Towards a Phenomenology of Architecture, Rizzoli New York,1980.
7. Donald Appleyard, Kevin Lynch, John R. Myer, The View from the Road, MIT Press1965
8. Benjamin Woolley, Virtual Worlds. Penguin Books,19931994
9. Peter Calthorpe, The Next American Metropolis, Princeton Architectural Press, 1993
10. ThomasA,Horan,DigitalPlaces:Buildingourcityofbits,UrbanLandInstitute, 2000.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the determinants of contemporary urban form and ways to understand their effects.
CO2	Knowledge to address issues of contemporary urban form through planning and design using appropriate tools.
CO3	Analyze the issues/ aspects of contemporary urban form through study of history of urbanism, contemporary urban theories, urbanism and urban design precedents.
CO4	Apply and addressing the effects of some of these aspects/ issues.
CO5	Analyze on globalization, digital revolution, contemporary processes, sustainability, etc.
C06	Application of Geographic Information Systems, diagramming and 3D Modeling 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	L		M	M					H	H		L
	CO2		H		H	M	M		M		L	M	
	CO3	L				L		M		M			M
	CO4		L							M		L	
	CO5	H	L	H	M			H	L				H
	C06			M		L	M						
3	Category	Professional Core (PC)											
4	Approval	7th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR201	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN II	3	0	0	3

OBJECTIVES:

- To provide an overview of various contemporary architects in terms of their works, design philosophies andprocesses.
- To investigate the effect of various digital technologies on architecture in the real and virtual Realms.

UNIT I	QUALITIES OF VIRTUAL ARCHITECTURE	9

Discussing the differences between the real and virtual space. Virtual space as the potential space.Qualities of the new space: Disconnection of the body, new laws of proximity and increased automatism and its influence on architectural form andspace.

UNIT II	MEDIA AND ARCHITECTURE	9

Visions unfolding/ Media Architecture as desirable/ Films as a space for virtual architecture.

UNIT III	ISSUES	9

Towardsnewparadigm–Amythorapromise./Needversusdesire/anxietyofnew/ identity andFashion.

UNIT IV	IDEAS AND WORKS OF CONTEMPORARY ARCHITECTS	12

Ideas and works of contemporary architects - 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.

UNIT V	SEMINAR PRESENTATION	6

Students presentation on the ideas and works of architects known for process oriented approach to architecture. Topics to be discussed with course faculty prior to presentation.

TOTAL: 45 PERIODS

REFERENCES:

1. L. Convey et. al. Virtual Architecture, Batsford, 1995.
2. William J Mitchell, City of bits: Space, Place and the Infobahn. MIT Press, Cambridge,1995.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Knowledge about the various design methodologies employed by contemporary architects
CO2	Analyse the use of computation and digital technologies in contemporary architectural design.
CO3	Evaluate the influence of various media, especially films, on architecture and viceversa.
CO4	Analyse the contemporary architecture works, design philosophies and processes.
CO5	To Design with all the terms and terminology of contemporary architecture.
C06	Apply the effect of various digital technologies on architecture in the real and virtual Realms.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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					H	H		L
	CO2	L	L		M								
	CO3	M						M					M
	CO4		H										
	CO5	L	M	L	L			H	L		L		H
	C06			M									
3	Category	Professional Core (PC)											
4	Approval	4th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR202	PERFORMANCE EVALUATIONOF BUILDINGS	2	0	2	3

OBJECTIVE:

- To investigate the simulation and audit techniques for assessing the energy performance, environmental response and impact of builtform.

UNIT I	INTRODUCTION TO BUILDING PERFORMANCE EVALUATION	3

Emerging role of performance evaluation in building design and master planning- Performance audit and rating systems- GRIHA, LEED IGBC and BREAM – Architectural Computation and performance audit- Introduction to ECOTECT.

UNIT II	PRINCIPLES OF SUSTAINABLE DESIGN	12

E‟s of sustainability **-** Integrated approach to environmental design – Case studies – Comparative analysis of green rating systems, LEED, BREAM and GRIHA – Cognitive , analytical and simulated modeling and design of buildings. Zero Carbon Footprint Building.

UNIT III	ENVIRONMENTAL ASSESSMENT METHODS AND MODELING FOR PASSIVE SYSTEMS.	12

Modelling and experimental techniques for building assessment/ evaluation and design – Basics of thermal comfort, solar shading/access/ control, day lighting, acoustics air movement etc. – issues and opportunities with current assessment modes/ evaluation tools- Evaluation and assessment based on Building type/ function and program – Building performance with respect to function, program, micro climate, urban planning, envelope design, material – Computer studio and simulation-Mathematical models of heat and mass transfer phenomena through building components: transfer function methods and numerical methods – Models of radiative and convective heat transfer phenomena withinbuildings

UNIT IV	ADVANCE ECOTECT AND ENERGY MODELLING	12

Integration of ECOTECT with BIM, RAPID ENERGY MODELLING- Modelling and performance simulation of existing buildings – residential-institutional-design of a new residential building withECOTECT

UNIT V	SEMINAR AND CASE STUDY PRESENTATION	6

Case study presentation of students on performance evaluation of a building identified by them and approved by the course faculty – Seminar on topics approved by the course faculty.

TOTAL: 45 PERIODS

REFERENCES:

1. Energy Audit of Building Systems – MoneefKrarti (Ph.D) – CRC Press2000
2. Clarke, J.A., "Energy simulation in building design", Adam Hilger Ltd, Bristol, 1985.
3. ESRU,. "ESP-r A Building Energy Simulation Environment; User GuideVersion 9 Series."ESRU Manual U 96/1, University of Strathclyde, Energy Systems Research Unit, Glasgow, 1996.
4. Kabele, K., "Modeling and analyses of passive solar systems with computer simulation", in Proc. Renewable energy sources, PP. 39 – 44, Czech Society for Energetics Kromeriz 1998 (inCzech).

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Knowledge on environmental assessment methods, audit and simulationtechniques.
CO2	Evaluate the architectural design processes and equip students with energy modeling skills.
CO3	Analyse the techniques for assessing the energy performance, environmental response and impact of built form.
CO4	Evaluation and assessment based on Building type/ function and program
CO5	Design implementing Performance audit and rating systems
C06	Analyse a case study on various performance evaluation 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	L							M				M
	CO2				H							M	
	CO3		M					L					M
	CO4			L		H				L			
	CO5	L											L
	C06						M					H	
3	Category	Professional Ability Enhancement Courses (PAEC)											
4	Approval	5th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR203	SERVICES IN HIGH RISE BUILDINGS	3	0	0	3

OBJECTIVES:

- This course will examine various services in high risebuildings.
- Understand how services integration can translate into an intelligent and energy efficient system which will enable sustainability of thestructure.

UNIT I	INTRODUCTION	3

Standards of high Rise buildings- Indian Standards and Global Standards on High Rise Buildings; Introduction to various services; their significance with regards to High Rise Buildings; Some examples of Buildings and services used in them A brief on evolution of High Rise Buildings. Aspects and Integration of services- Concepts of Intelligence Architectureand Building Automation

UNIT II	WATER SUPPLY AND WASTE DISPOSAL	9

Water supply and waste water collection systems- water storage and distribution systems- Planning and Design- Selection of pumps- rain water harvesting – Sewage collectionsystemsandrecyclingofwater-solidwastedisposal.“SomelatestTrends Observation,NBC“srecommendations.inthesеareascanbeincluded.

UNIT III	HVAC, ELECTRICAL AND MECHANICAL SYSTEMS	15

Natural and Mechanical Ventilation systems- Air conditioning systems and load estimation- Planning and design for efficiency-Basic concepts- Automation and Energy Management concepts. Natural lighting systems- Energy efficiency in lighting systems- load and distribution-Planning and Design for energy efficiency-Automation- basic concepts , Glass and Glazing system for natural lighting. Types of elevators, systems and services- Lobbydesign-
Escalators- safety principles, Some latest Trends, NBC“s recommendations.

UNIT IV	SAFETY AND SECURITY	6

Security systems- Access Control and Perimeter Protection- CCTV Intruder alarms-Passive fire safety- Fire Detection and Fire Alarm Systems- Planning and Design- NBC Some latest Trends

UNIT V	CASE STUDIES	12

Case Studies of High Rise buildings and skyscrapers through appropriate examples-Norman Foster; Ove Arup; Ken Yeang, etc.

TOTAL: 45 PERIODS

REFERENCES:

1. William J. Mcguinness, Benjamin Stein and John S. Reynolds, Mechanical and Electrical Equipment for Buildings, John Wiley & Sons, Inc.1980.
2. Donald Watson, Michael J. Crosbie and John Hancock Callender, Time-Saver Standards for Architectural Design Data, Mcgraw – Hill International Editions, 1997.
3. AKMittal,ElectricalandMechanicalServicesinHighRiseBuildingsDesignand Estimation Manual,2001.
4. YahyaMohamadYatim, Fire Safety Issues in High-Rise Residential Buildings: escape routes design and specification, Lambert Academic Publishing,2011.
5. Johann Eisele and Ellen Kloft, High-Rise Manual, Birkhäuser-Publishers for Architecture, 003.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Apply some or all of these services in one of their design projects.
CO2	Centric Knowledge of service base high rise design projects.
CO3	Understand the services integration.
CO4	Analyze on intelligent and energy efficient system which will enable sustainability of the structure
CO5	Apply various safety systems in high rise buildings
C06	Analyze a case study on various services in high rise 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	M						L				L
	CO2				M							M	
	CO3	M	L					L					M
	CO4			M		L				M			
	CO5	M											L
	C06					L	H					M	
3	Category	Professional Core (PC)											
4	Approval	4th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR2L1	ADVANCED ARCHITECTURAL DESIGN STUDIO I	0	0	12	6

OBJECTIVES:

- To understand in depth the increasing complexity of buildings today with respect to technology, services andplanning.
- To design within thiscontext.

The design studio will focus on emerging transformations in architecture in terms of aspects such as planning, building heights, floor area, technology, management, etc., It will explore the challenges of designing high rise and high tech buildings. It will enable collaborative learning through exploration,investigation and application of various parameters such as energy efficiency, green concepts, sustainability, services. The studio will integrate all these aspects through appropriate design projects.

TOTAL: 180 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the emerging technical areas of architecture.
CO2	Understanding of designing optimally, balancing the basics of architectural design with emerging new technical and planning parameters.
CO3	Ability to design buildings as positive additions to the city.
CO4	Ability to plan infrastructural buildings in positive additions to the city.
CO5	Understand in depth the increasing complexity of buildings
C06	Explore the challenges of designing high rise and high tech 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		L						L				L
	CO2				H	M				M		M	
	CO3	L	M				L	L					M
	CO4			L		M				M			
	CO5	H			H			M					L
	C06					M	L					M	
3	Category	Professional Core (PC)											
4	Approval	4th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR301	EMERGING PRACTICES IN HOUSING	2	0	2	3

OBJECTIVE:

- This course will examine the redefinition of contemporary housing within the contexts of multicultural cities due to globalisation.

UNIT I	INTRODUCTION	10

Introduction to this building type, from its industrial beginnings in London and Paris to New York City‟s Lower East Side and the 20th-century designs of Le Corbusier, Antonio Sant‟Elia, and Mies van der Rohe to mention a few.
Investigation of contemporary life and its influence on space and architecture- Globalization and influences on economy- Alternate housing solutions: Commune, Co Housing, Cooperatives, etc.

UNIT II	SINGLE FAMILY, MULTI FAMILY HOUSING	12

Review of latest developments in single family and multi family housing by examining the works of Wiel Arets, Shigeru Ban, Ben van Berkel, Kees Christiaanse, Philippe Gazeau, Frank O. Gehry,Steven Holl, Hans Kollhoff, Morger & Degelo, , Jean Nouvel, Kas Oosterhuis, MVRDV.

UNIT III	HIGH DENSITY HOUSING	9

Issues and concerns- Review of the current state of high density houses - the perspectives and future developments through a study of a few international projects.

UNIT IV	NEW FORMS OF LIVING AND HOUSING IN THE DIGITAL ERA	9

Hyper Housing- Multi cultural Housing- lab rooms and cyber homes- Network housing- hybrid buildings- individual sheltered residences; residence cities and bio homes for senior citizens- Works of UN Studio; FOA;; OMA

UNIT V	DEFINITION OF HOUSING IN THE INDIAN CONTEXT	20

Design strategies in the context of Indian metropolitan cities will be explored through a studio
Exercise.

TOTAL:60 PERIODS

REFERENCES:

1. Manuel Gausa and Jaime Salazer; Housing+ Single Family Housing; Birkhauser-Publishers for Architecture; 2005
2. Vincene Guillart; Sociopolis:Project for a city of the Future; ACTAR; 2004
3. Jingmin ZHOU; Urban housing Forms; Architectural Press; 2005
4. Adrienne Schmitz; Multifamily Housing Development Handbook; Urban Land Institute; 2001
5. Carles Bronto; Innovative Public Housing; Gingko Press; 2005.

6. COURSE OUTCOMES (COs)	
The student will be able	
CO1	To learn latest developmental and architectural
CO2	Understand the issues of latest development
CO3	To know about the design strategies of modern architects
CO4	Analyze the evolution of modern housing
CO5	Evaluate the development in various countries
C06	To understand international standards of Housing

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR302	RESEARCH METHODOLOGIES IN ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To make the students to distinguish various theoretical ideologies influencing the philosophy and values of architecture.
- To establish the sense of systematic inquiry in students mind to analyze and infer the issues and aspects relating to Architecture.

UNIT I	INTRODUCTION	9

Basic research issues and concepts- orientation to research process- types of research: historical,qualitative, co-relational, experimental, simulation and modeling, logical argumentation, case study and mixed methods- illustration using research samples.

UNIT II	RESEARCH PROCESS	9

Elements of Research process: finding a topic- writing an introduction- stating a purpose of studyidentifying key research questions and hypotheses- reviewing literature- using theory- defining, delimiting and stating the significance of the study, advanced methods and procedures for data collection and analysis- illustration using research samples.

UNIT III	RESEARCHING AND DATA COLLECTION	9

Library and archives- Internet: New information and the role of internet; finding and evaluating sources- misuse- test for reliability- ethics Methods of data collection- From primary sources: observation and recording, interviews structured and unstructured, questionnaire, open ended and close ended questions and the advantages,sampling- Problems encountered in collecting data from secondary sources.

UNIT IV	REPORT WRITING	6

Research writing in general- Components: referencing- writing the bibliography- developing the outline- presentation; etc.

UNIT V	CASE STUDIES	12

Case studies illustrating how good research can be used from project inception to completionreview of research publications.

TOTAL: 45 PERIODS

REFERENCES:

1. Linda Groat and David Wang; Architectural Research Methods;
2. Wayne C Booth; Joseph M Williams; Gregory G. Colomb; The Craft of Research, 2nd Edition; Chicago guides to writing, editing and publishing;
3. Iain Borden and Kaaterina Ruedi; The Dissertation: An Architecture Student"s Handbook; Architectural Press; 2000
4. Ranjith Kumar; Research Mehodology- A step by step guide for beginners; Sage Publications; 2005

5. John W Creswell; Research design: Qualitative, Quantitative and Mixed Methods Approaches; Sage Publications; 2002.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce methods and process of research, in order to understand the significance of the same with reference to landscape architecture and to develop skills of conducting and communicating research.
CO2	Introduction to research: Types of research and the process of formulating a research Project and their applications
CO3	Research Methods: Various methods of research, their relative advantages and disadvantages
CO4	Research Writing: Introduction to technical writing and presenting a research paper
CO5	Research Publication: Introduction to various form of publication of research
C06	Cyber security and laws related to the same. Plagiarism in research: Introduction to the concept, Problem of plagiarism & software to check the same

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR3L1	ADVANCED ARCHITECTURAL DESIGN STUDIO II	0	0	12	6

OBJECTIVES:

- To understand contemporary processes and tools in architectural design.
- To integrate the processes and tools in the design of projects, including those with increased complexity of parameters.

The design studio will focus on the role of emerging tools and processes for understanding and of complex and macro forces in the realm of the built environment as well as designing within this context. It would explore relationships between user group activity, movement, landform and urban form using diagramming and mapping tools to come up with creative prescriptions of certain projected scenarios. The studio will also emphasize on collaborative learning processes. The projects would be of macro scale involving large campus/ township oriented architectural projects as well as urban design.

TOTAL: 180 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand site context and to resolve complex landscape issues in urban and rural fabric, dealing with residential / commercial / institutional / recreational land use in relation to landform, vegetation & water
CO2	Documentation & Mapping, Analysis, Synthesis, Suitability, Zoning and planning with landscape land uses (for medium to large scale projects
CO3	Evolving landscape structure for sites & suggesting an appropriate landscape design with respect to ecological, functional, cultural & visual context.
CO4	Process of landscape project formulation and landscape design development/planning in response to contextual analysis, synthesis & theoretical bearings
CO5	Students will work on above mentioned in detail and will submit the work in the form of drawings and/ models
C06	To resolve complex landscape issues in urban and rural fabric with landscape design and Planning & To be able to derive an open space structure for the site/zone with suitable landuses/activities in response to the 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		
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR3L2	DISSERTATION	0	0	6	3

OBJECTIVES:

- To expose the students to the various thrust areas in architecture.
- To inculcate the spirit of research in architecture by providing opportunities to read on various issues.
- To expose the students to the finer details of technical writing.
- To provide a platform for a prelude to the „Design Thesis".

Dissertation is best expressed as „Design in text". It offers an opportunity to look at the research component in architecture in various thrust areas such as history, theor y, design and other value based aspects through texts. Students are encouraged to choose any topic of their interest. This may range from analyzing and a critique of the works of an architect, ideologies and philosophies of architects that get transformed spatially, history, typological architecture, sustainability issues and so on.the dissertation must comprise of an aim, the objectives, the scope and limitations of their dissertation, hypothesis (if any), methodology followed by extensive review of literature through references and documentation. The analysis of the work must be substantiated either empirically or through extensive arguments.

A dissertation could also be a Thesis preparation course and gives the student scope for independent study and opportunity to explore specific area of interest which will form the basis of his/ her design thesis project in the next semester. The topic will have to be approved at the start of the semester and reviewed periodically to a jury at the end of the semester.

TOTAL: 90 PERIODS

REFERENCES:

1. Iain Borden and Kaaterina Ruedi; The Dissertation: An Architecture Student"s Handbook; Architectural Press; 2000.
2. Linda Grant and David Wang, Architectural Research Methods, John Wiley Sons 2001.
3. Wayne C Booth; Joseph M Williams; Gregory G. Colomb; The Craft of Research, 2nd Edition; Chicago guides to writing, editing and publishing.
4. Ranjith Kumar; Research Mehodology- A step by step guide for beginners; Sage Publications; 2005.
5. John W Creswell; Research design: Qualitative, Quantitative and Mixed Methods Approaches; Sage Publications; 2002.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Develop the skill to identify, decipher and interpret issues relating to architecture based on research enquiry methods**.**
CO2	Understand CO2 Analyse different methods of conducting research and research writing.
CO3	Redefine a social Problem into a Research Problem,generate a methodology to prove it and convert it into technical /Popular Reports.
CO4	Apply,Analyse and Create Course Level Assessment Questions
CO5	Enumerate the types of Research and Illustrate with examples. & Discuss the Research Process in detail.
C06	Analyse different methods of conducting Research and suggest a suitable method for a particular Research & Discuss in detail the criteria for selecting a sampling procedure.

Mapping of Course Outcomes with Program Outcomes (POs)

(H/M/L indicates strength of 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		
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR4L2	BUILDING INFORMATION MODELING	0	0	6	3

OBJECTIVE:

- To equip students with skills and information to build comprehensive Building Information Models (BIM) using appropriate Digital software and Media.

UNIT I	INTRODUCTION TO THE FUNDAMENTALS	10

Key concepts of BIM - reading and manipulating the software Interface - navigating within views -selection methods - the importance of levels and grids- creating walls, doors, windows, and components - working with essential modification commands and load family. Creating floors, ceilings, and stairs - working with type and instance parameters - importing CAD drawings - understanding the project browser and type properties palettes - adding sheets - inserting views onto sheets - adding dimensions and text to the mode and plotting.

UNIT II	ADVANCED MODELING –FAMILY TYPES AND TOPOSURFACE MODELLING	20

Creating curtain walls, schedules, details, a custom family, and family types - “flex” a family with family types and work with reference planes - creating rooms and an area plan - tag components -customize existing wall styles. Create and edit a toposurface, add site and parking components -draw label contours - work with phasing - understand groups and links - work with stacked walls -and learn the basics of rendering and create a project template.

UNIT III	RENDERING AND MATERIAL APPLICATION	20

Creating custom walls, floors, and roofs - keynoting - working with mass elements - enhancing rendering with lighting - producing customized materials - Using sun and shadow settings - Walkthrough technique - adding decals - working with design options and worksets - and calculating energy analysis - managing revisions.

UNIT IV	BIM FOR COST ESTIMATING, PROJECT PHASING AND ADMINISTRATION	15

Model based Cost Estimating - Challenges in cost estimating with BIM- Cad geometrics vs BIM element description- Visual data models - Material substitutions and value engineering- detailed estimates and take-off sheets- XML and automated cost estimate- project phasing and management- 4D modeling -BIM for project lifecycles.

UNIT V	BIM FOR BUILDING ENERGY SIMULATION	25

Energy simulation for conceptual BIM models using massing- Detailed modeling using design elements- Rapid energy modeling and simulation with Autodesk® Revit® Conceptual Energy Analysis features to simulate performance from within Revit Architecture -Use Autodesk® Green Building Studio® to produce energy consumption, carbon neutrality and renewable potential reports.

TOTAL: 90 PERIODS

REFERENCES:

1. Eastman, C.; Teicholz, P.; Sacks, R.; Liston, K. (2008) BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. New York: Wiley.
2. Ray Crotty;(2011) The Impact of Building Information Modelling: Transforming Construction. Spons Architecture Price Book.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Develop building and infrastructure vocabulary to be able to describe a building, its components, and its systems, including the architectural, MEP (mechanical, electrical, plumbing), and structural components.
CO2	To understand and evolution and development of BIM from it origination to today.
CO3	To understand and able to compare, including advantages and disadvantages of BIM vs. 2D and 3D CAD
CO4	To understand and challenges and roadblocks still facing the use of BIM.
CO5	To understand and demonstrate proficiency of commonly used BIM software (Autodesk Revit), including project document development and professional presentation of a BIM model.
C06	To understand and understand applications of BIM, such as cost estimation, architectural renderings, interference checking, and modelling of energy consumption

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCAR4L1	ARCHITECTURAL THESIS	0	0	22	11

OBJECTIVES:

- To integrate the knowledge gained in the previous semesters with respect to issues/ tools of architectural design at a more advanced level.
- To understand and identify issues appropriate to a particular project or area of architecture, through independent thinking as well as to design in a manner appropriate to the project context.

The students will synthesize the areas of knowledge, skills and techniques acquired in the various courses of the previous semesters through a thesis project of their choice. This thesis project would be a design project with a strong research component. The project would desirably extend the critical position developed within the theory and studio projects as well as dissertation. The scale of the project could extend from individual site to settlement levels. The initial process shall be rigorous, incorporating background research on the topic, case studies, documentation of project issues, context, site and building information, programming. The process would culminate in design interventions at scales appropriate to the topic. The project shall desirably have the potential to serve as a starting point for practice and/ or further research.

Students will submit a detailed proposal on their topic of interest(s). The Proposal shall be approved by the thesis review committee. The thesis project will be reviewed periodically by the review committee. At the end of the semester, the final thesis will be submitted and presented through a viva voce examination before a jury.

TOTAL: 330 PERIODS

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.
C06	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	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											

PROFESSIONAL ELECTIVE COURSES

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR001	BUILDING MANAGEMENT AND CONTROL SYSTEMS	3	0	0	3

OBJECTIVES:

- This course provides a detailed exposure to students regarding the design & application in the field of life safety, electronic security & services automation requirements.
- To expose the students to the mandatory and inevitable integration of building management systems in building construction.

UNIT I	SAFETY SYSTEMS – FIRE ALARM & PUBLIC ADDRESS SYSTEM	9

Objective of a Fire Alarm System, essential components of a Fire Alarm System, Type of detection technology currently in use and Statutory Standards to be followed in design. Explanation of the essential Clauses of the the codes, and various types of Technologies employed in the Fire Alarm System, basic knowledge on how a Fire Alarm system works, designed and installed.

Objective of a Public Address System, essential components of a Public AddressSystem, various types of technologies currently in use and designguidelines to be followed andbasicknowledge on how a Public Address System works, is designed and installed.

UNIT II	SAFETY SYSTEMS – FIRE SUPPRESSION SYSTEM	9

Objective of a Fire Suppression System, Explanation on Fire triangle, Essential Components of a Fire Suppression System, different type of Fire Suppression Systems, detailed design criteria for Hand held extinguishers Wet Riser, Sprinkler Systems and various gas Based Fire Suppression System, and Type of Statutory Standards followed in Suppression, Explanation on the essential Clauses and Basic Knowledge on how a Fire Suppression System works, is designed and installed.

UNIT III	SECURITY SYSTEMS – ACCESS CONTROL SYSTEM & INTRUDER ALARM SYSTEM	9

Introduction to Access Control, Intruder Alarm, Essential Components of each System, and Various types of Technologies employed in the system, Basic knowledge as how they work, are designed and installed.

UNIT IV	SECURITY SYSTEMS – CCTV & PERIMETER PROTECTION	6

Introduction to CCTV, Perimeter protection system, Essential Components of each System, and Various types of Technologies employed in the system, Basic knowledge as how they work, are designed and installed.

UNIT V	INTEGRATED BUILDING MANAGEMENT SYSTEM	12

The objective of the Integrated Building Management System (IBMS), the list of utility, safety & security systems that are generally monitored & controlled through IBMS, the various components of IBMS, types of integration with the utility, Safety & security systems, explanation in detail on how each utility, safety & security system is integrated to IBMS, details of various parameters that can be monitored & controlled on each utility, safety & security system and the basic knowledge on how they work, are designed and installed.

TOTAL: 45 PERIODS

REFERENCES:

1. Building Automation Systems – A Practical Guide to Selection and Implementation, Maurice Eyke
2. The Principles and Practice of Closed Circuit Television, Mike Constant & Peter Turnbull
3. Rules for Automatic sprinkler Installation – second edition – Pub: Tariff Advisory Committee.
4. CCTV Surveillance, Herman Kruegle.
5. National Building Code of India 2005 (Part IV)
6. Bureau of Indian Standards IS2189, IS2190, IS15105, IS13039.
7. Fire Suppression Detection System, John L. Bryan.
8. Security Systems and Intruder Alarm System, Vivian Capel.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To ensure that every architect understands & designs the buildings that facilitates safe, code compliant, secure & comfortable buildings for the occupants.
CO2	This course provides a detailed exposure to students regarding the design & application in the field of life safety, electronic security & services automation requirements
CO3	To expose the students to the mandatory and inevitable integration of building management systems in building construction.
CO4	Understand the History and Definition of Building Management Systems
CO5	Understand Control Basics • Understand Direct Digital Control (DDC) systems for use in BMS
CO6	Implement Direct Digital Control Networking Basics • Perform DDC Programming

Mapping of Course Outcomes with Program Outcomes (POs)

(H/M/L indicates strength of 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			M			L				
	CO3	M			M						H		
	CO4		H				H					L	
	CO5	L		L				M					
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	14TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR002	APPROPRIATE TECHNOLOGIES AND SUSTAINABLE CONSTRUCTION	3	0	0	3

OBJECTIVES:

- The course will provide necessary knowledge and skills to enable the facilitation and transformation of places and spaces where culture and technology are in a state of rapid change and resources are scarce.
- It will examine self-help techniques of construction, adaptation, repair and management to understand what is involved in sustainable construction of domestic and community architecture.

UNIT I	INTRODUCTION	6

Architecture and the survival of the planet- Assessing patterns of consumption and their alternatives- Profit and politics- Natural building movement – new context for codes and regulations.

UNIT II	DESIGN PRINCIPLES	12

Principle 1: Conserving energy; Principle 2: Working with Climate; Principle 3: minimizing new resources; Principle 4: respect for users; Principle 5: respect for site; Principle 6: holism- Illustrated with examples.

UNIT III	SUSTAINABLE CONSTRUCTION	6

Design issues relating to sustainable development including site and ecology, community and culture, health, materials, energy, and water- Domestic and Community buildings using self help techniques of construction; adaptation, repair and management.-.portable architecture.

UNIT IV	SYSTEMS, MATERIALS AND APPLICATIONS	12

Adobe- Cob- Rammed Earth- Modular contained earth- light clay- Straw bale- bamboo- earthen finishes, etc.- their sustainability; adaptability to climate; engineering considerations, and construction methods; Waste as a resource Portable architecture to Applications through specific case studies.

UNIT V	CASE STUDIES FROM THE CONTEMPORARY SCENARIO	9

Ranging from small dwellings to large commercial buildings, drawn from a range of countries to demonstrate best current practice

TOTAL: 45 PERIODS

REFERENCES:

1. Brenda and Robert Vale; Green Architecture: Design for a sustainable future; Thames and Hudsson;1996
2. Lynne Elizabeth and Cassandra Adams; Alternative Construction: Contemporary Natural Building Methods
3. Victor Papanek; The Green Imperative; Thames and Hudson; 1995
4. Steven Harris and Deborah Berke; Architecture of the Everyday; Princeton Architectural Press;1997.
5. Pilar Echavarria; Portable Architecture- and unpredictable surroundings; Page One Publishing Pvt. Ltd.; 2005.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand necessary knowledge and skills to enable the facilitation and transformation of places and spaces where culture and technology are in a state of rapid change and resources are scarce.
CO2	It will examine self help techniques of construction, adaptation, repair and management to understand what is involved in sustainable construction of domestic and community architecture.
CO3	An understanding on the needs of alternative technologies in buildings.
CO4	An exposure to sustainable materials and construction.
CO5	Design issues relating to sustainable development including site and ecology
CO6	Portable architecture to Applications through specific case studies.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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				H				
	CO4		L				L					M	
	CO5	H		H				M					
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	10TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR003	ARCHITECTURE AND CRITICAL THEORY	3	0	0	3

OBJECTIVES:

- To introduce the idea of architecture as enmeshed in the society and a product of larger socio-cultural issues and practices, and not as an autonomous object determined by a hermetically sealed discipline.
- To introduce the various interdisciplinary critical theories and explain their interpretation of architecture.
-

UNIT I	INTRODUCTION	6

Definition of theory - Architectural theory and its nature, purpose and its relation to practice - overview of some traditional architectural theories- context for the rise of more critical theories in architecture – Introduction to Critical Theory- Architecture and Critical Theory.

UNIT II	POWER AND BUILT ENVIRONMENT	10

Definition of power- Forms of power- Power in the built environment at various scales - ideas of power and society, power-knowledge- Colonialism in India as a form of dominance- introduction to architecture and urbanism of colonialism in India- Production of Indo-Saracenic architecture- New Delhi as a part of imperial vision- Case studies of the architecture and urbanism of power in the modern world.

UNIT III	PLACE AND ARCHITECTURE	10

Critical reactions to modernity/ modernism with reference to the concept of context/ place- Critical Regionalism and architectures of resistance- Place and phenomenology in architecture

UNIT IV	SEMIOTICS AND ARCHITECTURE	10

Architecture as communication and representation- introduction to linguistic concepts of semiotics,structuralism, post structuralism and deconstruction- brief over view of postmodern and deconstructivist architecture with reference to these concepts.

UNIT V	CONTEMPORARY ISSUES IN ARCHITECTURE	9

Conditions of late capitalism and postmodern society- Society of spectacle- Architecture as spectacle and seduction- Theme parks and shopping malls- privatisation of public spacesaesthetisation of architectural issues- influence of globalisation and digital revolution on architectural processes- debates of heritage- gender and space.

TOTAL: 45 PERIODS

.

REFERENCES:

1. Neil Leach (ed) Rethinking Architecture, Routledge 2000
2. Michael Hays (ed) Architectural Theory since 1960,MIT Press, 2000
3. Kate Nesbitt, Theorizing a New Agenda for Architecture, Princeton Architectural Press, 1996
4. Anthony D. King, Colonial Urban Development, Routledge & Paul, London, 1976
5. Thomas Metcalf Imperial vision, Oxford, 2002
6. Jane Rendell, Barbara Penner, Iain Borden, Gender Space Architecture, Routledge, 2000
7. Kim Dovey, Framing Places: Mediating Power in Built Form, Routledge 1999.
8. Neil Leach, Anaesthetics of Architecture, MIT Press 1999,
9. Guy Debord. Society of Spectacle,Ian Borden & Jane Rendell,(ed), Intersections, Routledge 2000
10. Paul Allan Johnson,Theory of Architecture, Routledge 2000
11. Christian Norberg Schulz- Towards a Phenomenology of Architecture, Rizzoli New York, 1980

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understanding of the effect of contemporary theories of media on contemporary architectural design.
CO2	Understand the Increased Automatism and its influence on Architectural Form and Space
CO3	Understand the methods of computation Design and diagrammatic representations
CO4	Application of various concepts of process of digital architecture design
CO5	Understanding of various contemporary design process and their relation to computation
C06	To understand the architectural issues and architectural processes.

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
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		
C06				M				L				
Category	Professional Core(PC)											
Approval	04TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR004	GIS MODELLING IN URBAN PLANNING	3	0	0	3

OBJECTIVE:

- To examine the role and application of Geographic Information Systems in environmental design, community charities and other urban design projects.

UNIT I	INTRODUCTION	6

GIS – Spatial data, non Spatial data, Plan, Map, Scale, Map Projection, GPS, GCP collection, Spectral signature curve, Image processing – Geo coding / Geo referencing, GIS software, Two tier architecture, Three tier architecture, Thin client, Thick client.

UNIT II	DATABASE CONCEPTS	9

Data structures, Databases, Files, Types of Tables, Table operations, Creating a Table, Accessing Records in a Table, Manipulating records in a Table, Modifying Table structure, Reports,Advantages of database, Primary key and data access, Composite primary key, Defining a primary key, Sorting, Indexing, Master Detail relationships, Types of relationships, Foreign key, Deleting,updating and adding records to linked tables, ER Diagram, Data Model – Physical, logical and conceptual.

UNIT III	SPATIAL DATA	9

Comparative methods for obtaining images, Aerial Photograph, Satellite Imagery – High resolution imagery – LISS, PAN, MSS – Ortho rectification, Digitization – Layers, Digital Elevation model,Digital Terrain Modelling, Existing maps – Problems and Issues, Rubber sheeting, Digitization,overlay, union, intersection.

UNIT IV	INTRODUCTION TO GIS SOFTWARE	9

Arc Info – Coverage – Arc, Node, Tics, Add, get, put, Map extent, edit, Topology creation – Clean,Build, Tables – Creating tables, updating tables, join, drop item, Export, Import, overlay,
union,intersection, buffer.

UNIT V	MODELLING GIS PROJECTS FOR URBAN AREAS	12

Preparation of Land use map, Land use suitability analysis, Screen design, Visual Basic application using Map objects.

TOTAL: 45 PERIODS

REFERENCES:

1. Information systems for Urban Planning – Robert Laurini
2. Modelling our world – ESRI Press
3. An Introduction to Data base Systems – C.J.Date
4. Fundamentals of Data base Management System by Elmasri & Navethi
5. ESRI (1992) Understanding GIS, The Arc Info Methods, ESRI, USA.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce the principles of aerial and satellite based remote sensing for studying earth resources.
CO2	To introduce geophysical well logging techniques for interpretation of subsurface geology
CO3	well logging, classification of well logging methods, formation evaluation and its importance.
CO4	Basic principles, SP log, normal and lateral logs, focused logs, micro resistivity toolsand their role in formation evaluation; Applications.
CO5	Basic principles of different types of radiation logs including gamma ray, gamma-gamma,neutron thermal and chlorine logs; Porosity determination and cross plots; Applications
C06	Permeability, bound and free-water estimation using NMR logging techniques; ApplicationsCaliper, dip meter, cement bond logging, casing collar locators, temperature logging.

Mapping of Course Outcomes with Program Outcomes (POs)

(H/M/L indicates strength of 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		
	C06				M				L				
3	Category	Professional Elective(PC)											
4	Approval	10 TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR005	ANTHROPOLOGY AND ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To understand the relationship between society and the making of the built environment.
- To understand phenomenology and the role of meaning in built form.
- To look at place making from the architectural as well as urban design point of view.

UNIT I	RELATIONSHIP BETWEEN CULTURE, SOCIETY, ANTHROPOLOGY AND ARCHITECTURE	6

Concepts of culture, society, politics and anthropology – relation between society and built environment – introduction to cultural anthropology view of architecture.

UNIT II	ANTHROPOLOGY OF TRADITIONAL ARCHITECTURE	10

Architecture as a Process – kinship and house societies – perceptions of built form – conceptions of space – symbolism and technology – study of the above through case study of traditional architecture in India, Asia and Africa.

UNIT III	ANTHROPOLOGY AND PLACE MAKING	15

Conditions of modernity –Fragmentation of society – Heidegger and notions of dwelling – C Noeberg Schultz and notions of Genius Loci Rapoport and studies on the meaning of built environment – Joseph Rykwert and the idea of house – Bollnow and idea of space – Jan Pieper and the notions of sacred space.

UNIT IV	AN OVER VIEW OF URBAN ANTHROPOLOGY	6

Meaning of urban studies and urban anthropology – role of cities – urban ethnography, primary units, major components and units of integration – anthropology and contemporary urban issues.

UNIT V	SEMINAR	8

Students would make presentations exploring the relevance and impact of anthropological studies on contemporary architecture and design through readings/case studies. The proposal must be discussed with course faculty prior to presentation.

TOTAL: 45 PERIODS

REFERENCES:

1. Roxanna Wasterson; The living House Anthropology of Architecture in S E Asia; OxfordPress.
1. Claire Melhuish (ed); Architecture and Anthropology – AD Vol 66 No 11/12 Nov - 1996
2. Joseph Rykwert; On Adams house in Paradise; MIT Press 1987
3. O F Bollnow; Mann, Bensch and Raum, Stuttgart; 1963.
4. Joseph Rykwert – Idea of a Town: The Anthropology of Urban Form in Rome; 1976.
5. Nold Egenter; The review of the Primitive in Architecture – Architectural Anthropology – Research Series Vol. I and II; Structura Mundi; 1992 and 1996.
6. Edwin James; Anthropology of the City; Prentice Hall; 1977.
7. J Carstern and S H Jones; About the house: Levi Strauss and Beyond; Cambrige UniversityPress; 1955.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	A comprehensive understanding of architecture and urbanism as expressions of particular societies in time and place.
CO2	To understand the relationship between society and the making of the built environment.
CO3	To understand phenomenology and the role of meaning in built form.
CO4	To look at place making from the architectural as well as urban design point of view
CO5	perceptions of built form – conceptions of space
CO6	role of cities – urban ethnography, primary units, major components

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		L				L				M		
	CO3	M		M					L				
	CO4		H			H							L
	CO5	M			L			M					
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	12 TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR006	MATERIAL CONSERVATION	3	0	0	3

OBJECTIVES:

- To study materials, structural systems, buildings and elements produced by historical technologies in order to develop understanding of their evolutionary, chronological and stylistic context.
- To use this understanding to outline causes of deterioration and repair as well as look at the remedial and preventive measures that need to be taken to preserve the building fabric.

UNIT I	CONSERVATION TECHNIQUES	9

Decay of monuments – reasons to decay – restoration techniques – soil and structure conservation – cleaning of monuments – reconstruction of monuments- Decay Mapping – Quantifying techniques- Introduction to structural analysis.

UNIT II	COMPOSITION, CHARACTERESTICS AND DETERIORATION OF MASONRY MATERIALS	9

Brick- Stone- Composite masonry- causes for decay and deterioration- remedial measures- Introduction to the significance and use of the lime – working with lime – repairing and replacing plaster - Issues concerning terracotta and mud- use of consolidants.

UNIT III	COMPOSITION, CHARACTERESTICS AND DETERIORATION OF OTHER STRUCTURAL MATERIALS	9

Use and repair of iron and steel members – Understanding wood and timber structures / methods to conserving timber structures

UNIT IV	CASE STUDIES	9

Case studies at the national, international and state level conservation projects done by ASI, INTACH & Conservation Architects- assessment and evaluation.

UNIT V	MATERIAL CONSERVATION AND ADAPTIVE REUSE	9

Studio on Adaptive reuse/ restoration project / building in Existing fabric.

TOTAL: 45 PERIODS

REFERENCES:

1. Bernard Feilden, Conservation of Historic Buildings, 2nd Edition, Butterworth, 1994.
2. Martin E Weaver; Conserving buildings: Guide to Techniques and materials, Revised Edition; Wiley; 1997
3. J. Stanley Rabun; Structural Analysis of Historic buildings: Restoration, Preservation and
1. Adaptive Reuse; Applications for Architects and Engineers; Wiley 2000
4. Kirk Urwin J.; Historic Preservation Handbook; Mc Graw hill 2003
5. Ernest Burden; Illustrated Dictionary of Architectural Preservation; McGraw hill 2003.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To study materials, structural systems, buildings and elements produced by historical technologies in order to develop understanding of their evolutionary, chronological and stylistic context.
CO2	To use this understanding to outline causes of deterioration and repair as well as look at the remedial and preventive measures that need to be taken to preserve the building fabric.
CO3	A holistic understanding of the physical processes of building, including gaining knowledge about historical, material and cultural aspects.
CO4	Gaining sensitivity and knowledge with respect to process of physical interventions in historic buildings.
CO5	Decay Mapping – Quantifying techniques- Introduction to structural analysis.
CO6	Use and repair of iron and steel members – Understanding wood and timber structures / methods to conserving timber 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				H					M		
	CO2		M				L					M	
	CO3	M			L					L			
	CO4		M				M						L
	CO5	M				M					L		
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	13TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR007	URBAN LANDSCAPE DESIGN	3	0	0	3

OBJECTIVE:

- To expand the students knowledge on landscape within urban areas and open spaces in Urban context.

UNITI	INTRODUCTION	6

City and pattern – hierarchy of streets and squares – spatial organization and land use –road net works and basic services. Open spaces with in urban environment.

UNIT II	URBAN SPACES	9

Cultural, social and aesthetic value of urban spaces and its perception, Imageability, Townscape elements. Urban space enhancement.

UNIT III	OPEN SPACE SYSTEM	9

Open space development in urban design context. Evolution of public park as a major component of urban landscape. Open space development in new towns. Park systems, water fronts. Green infrastructure. Urban ecology, urban water sheds.

UNIT IV	ELEMENTS IN URBAN LANDSCAPE	12

Design of public parks, roads, green ways, parkways, promenade and plaza. Public art. Plant selection criteria, furnishings and lighting of public space, maintenance and management of public spaces and parks,

UNIT V	CASE STUDIES	9

Contemporary urban landscape issues. Case studies-Study, understanding and analysis of known examples at the national and international levels.

TOTAL: 45 PERIODS

REFERENCES:

1. Garden Cullen, The concise Townscape, Architectural press, London.
2. Kevin Lynch, Image of City, Cambridge, MA, 1961.
3. Henry F. Arnold, Trees in Urban Design, Van Nostrand Reinhold Company.
4. Matthew Carmona, Tim Heath, Public places – Urban spaces, Architectural press, 2003.
5. Michael Hough, Cities and natural process, Routledge, 1995.
6. Donald Watson, Alan plattns, Roberta shibley, Time savers standards for urban design, McGraw hill, 2003.
7. Elements and total concept of urban landscape design, Graphic –sha publishing Co, 2001.
8. Tom turner, city as landscape, E and FN spon, 1996.
9. Cliff Tandy, Handbook of urban Landscape, Architectural Press, 1970.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand the Types, characteristics and elements of urban open spaces.
CO2	Analyze the Case studies of urban landscapes.
CO3	Knowledge on landscape within urban areas and open spaces in urban context.
CO4	Apply spatial organization and land use
CO5	Design the perception, Imageability, Townscape elements.
CO6	Analyse Urban space enhancement.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		L				L					H	
	CO3	M			M			H					
	CO4		L				L				M		
	CO5			H					H				M
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	2ND Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR008	LANDSCAPE ECOLOGY AND PLANNING	3	0	0	3

OBJECTIVES:

- To understand any developmental activity involves intervention in the natural processes and to minimize the impact due to this intervention.
- To outline the evolution of landscape planning, its premises and the process.
-

UNIT I	ECOLOGY	9

Understanding the ecosystem and their functioning — components of ecosystem - natural process- Fundamentals of ecology - Ecological processes and dynamics– understanding ecological concepts like population growth, regulation, carrying capacity- colonization and succession - stability and resilience of ecosystem – ecosystem degradation.

UNIT II	LANDSCAPE ECOLOGY	9

Introduction to landscape ecology – formation of various landforms – landforms and landscape process – pattern and structure of landscapes– concepts of patch, corridor and matrix –landscape dynamics and function – topological and chorological process within landscape - concept of landscape metrics – understanding dynamic interaction between landscape structure and function – ecological services of landscape.

UNIT III	LANDSCAPE PLANNING	9

Relationship between man and nature – analytical aspect of landscape - the natural and cultural setting - evolution of landscape planning –concepts and projects of McHarg, Carl Steinite, Warren Manning, Augus Hills, Phil Lewis – Izank Zonneveld, Ervin Zube - landscape planning models – METLAND concept

UNIT IV	PROCESS IN LANDSCAPE PLANNING	9

The purpose of landscape planning – domain and context for landscape planning – principles of planning – procedure in landscape planning - problem defining, goal setting, inventory and analysis - basic of collecting and analyzing, projecting and presenting data in landscape planning, visual assessment and aesthetic dimension.– Suitability analysis – techniques for identifying preferences - Planning options – proposing landscape plan.

UNIT V	CASE STUDIES: LANDSCAPE PLANNING	9

Reclamation and restoration of derelict landscapes - conservation and preservation of ecological fragile areas such as wetlands, creeks etc. - conservation ordinances. Case studies on landscape regional planning - policies and landscape.

TOTAL: 45 PERIODS

REFERENCES:

1. Richard T.T.Forman & Michel Godron , Landscape Ecology, John Wiley & Sons; 1986
2. Tom Turner, Landscape Planning and Environmental Impact Design, UCL Press, London,1998.
3. Ervin H. Zube, Robert O Brush, Julios G.Y.Fabos, Landscape assessment – values, perceptions, 1975.
4. G. Tyler Miller Jr., Living in the Environment: Principles, Connections, and Solutions, Brooks / Cole publishers co., 2004.
5. William M. Marsh, Landscape planning – Environmental Application, John Wiley and sons Inc., 1997.edition 1979).

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understand theBasics of Ecology
CO2	Analyse the Basics of Landscape Ecology
CO3	Apply Landscape planning in historical perspective
CO4	Evaluate the evolution of landscape planning concepts and projects
CO5	Analyse Purpose of landscape planning, its domain and context for planning landscapes
CO6	Understanding the policies, conservation and preservation of landscapes

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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				L			
	CO3	H			H						M		
	CO4		L				L						M
	CO5	H				M		L					
3	Category	PE(PROFESSIONAL ELECTIVE)											
4	Approval	09TH Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR009	WEB DESIGN AND PORTFOLIO PRODUCTION	0	0	6	3

OBJECTIVES:

- students should be skilled to develop their portfolio in the form of web pages
- to equip them with required software skills

UNIT I	INTRODUCTION TO WEB DESIGN	15

Basics of web design – Introduction to software used for web design – ADOBE IMAGE READY, DREAMWEAVER, FLASH etc.

UNIT II	STATIC PAGES	15

Slice – URL in ADOBE IMAGEREADY. Creation and Editing of site map – layer, tables, frameset, -CSS style – Forms – tools like insert, roll over etc., in DREAMWEAVER.

UNIT III	ANIMATION IN FLASH	15

Introduction to MACROMEDIA FLASH, importing other file formats to Flash-saving and exporting Flash files, Frame by frame animation – Motion Tweening – Shape Tweening.

UNIT IV	INTRODUCTION TO SCRIPTING	15

Using Timeline – Frames –Key frames- Creating and using Symbols- Simple scripting in flash – Publishing SWF files.

UNIT V	DEVELOPING A WEB SITE	30

Using the skills and concepts learnt with the ADOBE IMAGEREADY, DREAM WEAVER, FLASH softwares . students will develop their portfolio in the form of web pages. These pages have to be uploaded in free public domains.

TOTAL: 90 PERIODS

REQUIRED READING

1. Photoshop 7 Bible Professional Edition, Wiley John & Son INC, New York, DekeMcClelland, 2000.
2. Flash Web Design, The Art of Motion Graph, Curtis Hillman, New Riders Publishing, Indianapolis, IN. U.S.A, 2000
3. M.E. Morris, and R.J. Hinrichs, Web Page Design, Prentice Hall, 1996.

4. Mark Von Wodtke, Mind over Media : Creative Thinking Skills for Electronic Media, McGrawhill, New York, 1993
5. Adobe Flash CS3 professional on demand by Steve Johnson, Andy Anderson, Perspection inc, 2012.

REFERENCES

1. Adobe Photoshop CS3 studio techniques, Ben Wilmore, 2012.
2. Adobe Dreamweaver CS6 classroom in a book, Adobe creative team, 2012.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand Basics of web design,Introduction to software used for web design
CO2	To understand the Creation and Editing of site map layer, tables, frameset, CSS style tools like insert, roll over etc
CO3	Introduction to macromedia flash, importing other file formats to Flash- saving and exporting Flash files, Frame by frame animation
CO4	Using Timeline ,Frames ,Key frames, Creating and using Symbols Simple scripting in flash
CO5	Using the skills and concepts learnt with the adobe image ready, dream weaver, flash software's. Students will develop their portfolio in the form of web pages. These pages have to be uploaded in free public domains.
C06	To implement with the web design and to prepare a model in 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	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		
	C06				M				L				
3	Category	Professional Elective(PE)											
4	Approval	6th Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PEAR010	SUSTAINABILITY AND ENERGY CONSERVATION IN LANDSCAPE ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To expose the students on the issues of sustainability at the global level.
- To Focus on the energy conservation landscape and sustainability at the micro level.
- Sustainable landscape design for various climates of India

UNIT I	INTRODUCTION TO SUSTAINABILITY	10

Need and concept of sustainability, Brundtland report, World Commission on environment and development, sustainable development, sustainable growth, sustainable economy and sustainable use. Visions of sustainability. Source and ethics of sustainability. Sustainability and Climate Change.

UNIT II	SUSTAINABLE SITE	7

Sustainable site – LEEDS, BREAM, rating erosion and sedimentation control, site selection, urban development, landscape and exterior design etc., Green Building in the context of sustainability. Ecology and sustainability. Eco-City.

UNIT III	INTRODUCTION TO ENERGY CONSERVATION IN LANDSCAPE	9

Energy conservation and sustainability, principles of energy systems, energy and global environment, scope for energy conservation in landscape.

UNIT IV	ENERGY CONSERVATION METHODS IN LANDSCAPE ARCHITECTURE-CASE STUDIES	10

Various methods of energy conservation in landscape architecture, energy conservation techniques in various climates- hot and humid, hot dry, etc. Energy efficient site planning and landscape development. Energy efficient planting design.

UNIT V	SUSTAINABLE LANDSCAPE PRACTICES	9

Sustainable landscape maintenance and management, Sustainable planning and city form. Sustainable urban landscape, landscape sustainability at the national and regional level.

TOTAL: 45 PERIODS

REFERENCES:

1. John.F.Benson and Maggie.H.Roe, Landscape and sustainability, John Wiley Publication, NewYork, 2000.
1. O.R.Gray, Landscape Planning for Energy Conservation,
2. Anne Simon Moffat and Marc Schiller, Landscape design that saves energy, William Monow and co.,Inc., New York, 1981.
3. Publications of Centre for science and environments, TERI, New Delhi
4. Grady Clay, Water and the landscape McGraw-Hill Inc.,US; First Edition edition 1979).

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Knowledge to make aware of the Sustainable design aspects for landscape and Green buildings design concepts.
CO2	Analyze the sustainable development in relation to natural resource conservation energy conservation, environmental pollution and conservation of bio-diversity
CO3	Apply the Global issues such as global warming, ozone layer depletion, greenhouse gases and depletion of natural resources in relation to energy generation
CO4	Understand the Sustainable development from the perspective of regional and urban planning; Issues at regional and micro level.
CO5	Apply the Climate considerations in design of buildings in various climates;
C06	Analyze the Eco-friendly 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		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		
	C06				M				L				
3	Category	Professional Elective (PE)											
4	Approval	04TH Meeting of Academic Council											

.

M. ARCH (LANDSCAPE) – FULL TIME
CHOICE BASED CREDIT SYSTEM I TO IV SEMESTERS
CURRICULA & SYLLABI

M - ARCH LANDSCAPE (SEMESTER I)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/ S**	**C**
THEORY						
1	P18PCLA101	GEOLOGY AND SOILS	3	0	0	3
2	P18PCLA102	HYDROLOGY AND MICRO CLIMATE	3	0	0	3
3	P18PCLA103	PLANTING AND HORTICULTURAL PRACTICES	3	0	0	3
4	P18PELA104	SITE PLANNING AND DETAILING	1	0	4	3
5	P18PCLA105	TRADITIONAL AND CONTEMPORARY LANDSCAPES	3	0	0	3
STUDIO						
1	P18PCLA1L1	URBAN LANDSCAPE DESIGN	0	0	12	6
TOTAL			**16**	**0**	**4**	**21**

M - ARCH LANDSCAPE (SEMESTER II)						
SL. NO.	**COURS E CODE**	**COURSE TITLE**	**L**	**T**	**P/S**	**C**
THEORY						
1	P18PCLA201	LANDSCAPE CONSTRUCTION	0	0	6	3
2	P18PCLA202	PLANTING DESIGN	3	0	0	3
3	P18PCLA203	LANDSCAPE ECOLOGY AND PLANNING	3	0	0	3
4	P18PELA204	PROFESSIONAL ELECTIVE-I	_	_	_	3
5	P18PELA205	PROFESSIONAL ELECTIVE-II	_	_	_	3
STUDIO						
1	P18PCLA2L1	LANDSCAPE DESIGN STUDIO I	0	0	12	6
TOTAL			**8**	**0**	**16**	**22**

M - ARCH LANDSCAPE (SEMESTER III)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/ S**	**C**
THEORY						
1	P18PCLA301	ENVIRONMENTAL LEGISLATION AND EIA	3	0	0	3
2	P18PCLA302	RESEARCH METHODOLOGIES IN ARCHITECTURE	3	0	0	3
4	P18PELA303	PROFESSIONAL ELECTIVE-I	_	_	_	3
5	P18PELA304	PROFESSIONAL ELECTIVE-II	_	_	_	3
STUDIO						
1	P18PCLA3L1	ADVANCED LANDSCAPE DESIGN STUDIO II	0	0	14	7
2	P18PCLA3L2	DISSERTATION	0	0	6	3
TOTAL			**6**	**0**	**18**	**21**

M - ARCH LANDSCAPE (SEMESTER IV)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/ S**	**C**
STUDIO						
1	P18PCLA401	PROFESSIONAL PRACTICE OF LANDSCAPE ARCHITECTURE	3	0	0	3
2	P18PCAR4L1	THESIS	0	0	22	11
TOTAL			**3**	**0**	**22**	**14**

LIST OF ELECTIVES- M. ARCH (LANDSCAPE)						
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P/ S**	**C**
THEORY						
1	P18PELA001	APPLICATION OF GIS IN LANDSCAPE DESIGN	3	0	0	3
2	P18PELA002	COMPUTER APPLICATIONS AND MANAGEMENT INFORMATION SYSTEMS	3	0	0	3
3	P18PELA003	LANDSCAPE MANAGEMENT	3	0	0	3
4	P18PELA004	GIS MODELING IN URBAN PLANNING	3	0	0	3
5	P18PELA 005	CONTEMPORARY PROCESSES IN ARCHITECTURAL DESIGN I	3	0	0	3
6	P18PELA006	ARCHITECTURE AND CRITICAL THEORY	3	0	0	3
7	P18PELA007	WEB DESIGN AND PORTFOLIO PRODUCTION	0	0	6	3
8	P18PELA 008	SUSTAINABILITY AND ENERGY CONSERVATION IN LANDSCAPE ARCHITECTURE	3	0	0	3
TOTAL			**21**	**0**	**6**	**24**

L- Lecture **T**- Tutorial **P**- Practical **S**- Studio **C**- Credits

PROFESSIONAL CORE COURSES (PC)

Sl. No.	Course Code	Course title	Category	Contact periods	L	T	P	C
1.	P18PCLA101	GEOLOGY AND SOILS	PC	3	3	0	0	3
2	P18PCLA102	HYDROLOGY AND MICRO CLIMATE	PC	3	3	0	0	3
3	P18PELA104	SITE PLANNING AND DETAILING	PC	3	3	0	0	3
4.	P18PCLA103	PLANTING AND HORTICULTURAL PRACTICES	PC	3	3	0	0	3
5	P18PCLA105	TRADITIONAL CONTEMPORARY LANDSCAPES	PC	3	3	0	0	3
6.	P18PCLA201	LANDSCAPE CONSTRUCTION	PC	6	0	0	6	3
7	P18PCLA202	PLANTING DESIGN	PC	3	3	0	0	3
8	P18PCLA203	LANDSCAPE ECOLOGY PLANNING	PC	3	3	0	0	3
9	P18PCLA301	ENVIRONMENTAL LEGISLATION AND EIA	PC	3	3	0	0	3
10	P18PCLA302	RESEARCH METHODOLOGIES IN ARCHITECTURE	PC	3	3	0	0	3
11	P18PCLA401	PROFESSIONAL PRACTICE OF LANDSCAPE ARCHITECTURE	PC	3	3	0	0	3
12	P18PCAR4L1	THESIS	PC	22	0	0	22	11

PROFESSIONAL ABILITY ENHANCEMENT COURSES (PAEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	P18PCLA1L1	URBAN LANDSCAPE DESIGN	PAEC	12	0	0	12	6
2.	P18PCLA2L1	LANDSCAPE DESIGN STUDIO I	PAEC	12	0	0	12	6
3.	P18PCLA3L1	ADVANCED LANDSCAPE DESIGN STUDIO II	PAEC	14	0	0	14	7
4.	P18PCLA3L2	DISSERTATION	PAEC	6	0	0	6	3

M. ARCH (LANDSCAPE) I TO IV SEMESTERS OF CURRICULA AND SYLLABI

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA101	GEOLOGY AND SOILS	3	0	0	3

OBJECTIVES:

- Introduction to the characteristics and impact of the landform which are shaped by the forces of the Earth and its influences on the landscape.
- This course introduces these processes and their impact. In addition the objective of the course is also to give detailed knowledge on the soils.

UNIT I	INTRODUCTION	15

The Earth – Origin of Earth, Solar system. Earth's Structure, Composition, Land and Sea distribution , Earth and its Atmosphere. Rock-Rock forming minerals – Igneous, Metamorphic and Sedimentary rocks, Economic importance of mineral deposits. Geomorphic process : Epigenic or Exogenic process – Weathering, Erosion, Mass wasting, Fluvial cycle, Groundwater, Wind, Seas and Oceans, Glaciers. Hypogenic or Endogenic process – Earth quake, Tsunami, Fold, Fault, and Volcanism, Platetectonics.

UNIT II	STUDY OF LANDFORMS	12

Evolution of land forms: Land forms produced by geomorphic process –Reclamation of land forms , Land forms along coasts. Man's intervention into Ecology and Environment- case studies in India, Deterioration of landscapes by Mining of minerals. Suitability of land for various developments. Surface and Groundwater resources management, Quality of water for drinking. Hydraulic effects caused by rapid urbanization.. Concept of rainwater harvesting.

UNIT III	SOIL CHARACTERISTICS	6

Soil forming minerals –Weathering & Erosion, Soil profile, Role of climate, Rainfall, Vegetation, Topography and Time factors in soil formation. Soil classification, Soil water, Soils of India. Soil properties, Physical, Chemical and Biological properties,
Sustainability of soil for development activities.

UNIT IV	SOIL ANALYSIS	6

Soil analysis, Soil survey and field mapping, land capability classifications. Role of remote sensing in soil mapping.

UNIT V	SOIL MODIFICATIONS	6

Soil modifications, Problems of soils, Acid, Alkaline, Saline soils, soil pH, Essential mineral nutrients of soils, Manure and Fertilizers. Soil conservation, type, factors, methods of conservation, prevention of soil erosion, Soil conditioning, soil mixtures and alternative to soils.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Characteristics of landforms, causes and effects.
CO2	Soil characteristics, causes and effects and modifications.
CO3	Methods of analysis of soils.
CO4	Compare and contrast stress versus strain in the Earth's crust.
CO5	Identify geologic structures created by deformation.
CO6	Investigate the causes and common locations of earthquakes.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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						L		
	CO3	M					M						
	CO4		L						M				H
	CO5	H				H						L	
3	Category	PC											
4	Approval	29THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA102	HYDROLOGY AND MICRO CLIMATE	3	0	0	3

OBJECTIVES:

- Introduction of basic hydrology and its link with various landscape processes.
- To understand the issues, involved in macro and micro climate.
- To expose the students on Landscape design in various climate types
- To have and understanding on the evaluation tools in micro climate.

UNIT I	HYDROLOGICAL SYSTEMS	6

Hydrological cycles and sources of water. Characteristics and management of drainage basins. Types of flow channels, management of surface water. Ground water occurrence, aquifer recharge areas, infiltration, water intrusion areas, water bearing properties of geological formations, salt water intrusion, leaching etc.,

UNIT II	WATER MANAGEMENT	9

Ground water management, sources of ground water pollution and its control, use of saline brackish water for development. Impacts of hydrology on environment and landscape development, rain water harvesting methods, water treatment techniques, sewage water treatment and reuse in landscape, waste water and sewage water disposal methods on different types of soils, septic tank, soak pit designs.

UNIT III	INTRODUCTION TO THE CLIMATE	12

General Climatology. Composition of atmosphere, Elements of climate. Climate and Civilization, Climate classification worldwide and India. Climate – Macro, Micro and Crypto Climate, Urban and Rural Climate. Global Warming and Climate Change.

UNIT IV	CLIMATE AND LANDSCAPE DESIGN	10

Soil classification and vegetation in the tropics. Hard, Soft landscape and Climate. Pollution effects in Landscape. Evaluation tools of Micro climate. Landscaping in various climates of tropics. Role of landscape in energy conservation.

UNIT V	MICRO CLIMATE CONTROL	8

Impact of natural and man-made elements on climate. Radiation, wind, temperature, humidity and precipitation modification. Sustainable micro climatic design. Integration of microclimatic information in design and case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Knowledge about water management.
CO2	General understanding of climate and elements of micro climate and the relationship to landscape elements.
CO3	An understanding of micro climate modifiers.
CO4	The students obtain the complete knowledge on hydrologic cycle, hydrometeorology and formation of precipitation.
CO5	The students are able to apply the various methods of field measurements and empirical formulas for estimating the various losses of precipitation, stream flow and runoff.
CO6	The students know the various methods of rainwater and runoff harvesting. Then apply the knowledge of soil erosion and sedimentation to estimate the life of the reservoir.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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					L			
	CO3		M			H					L		
	CO4	M						M					L
	CO5		L		L					M			
3	Category	PC											
4	Approval	26THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA103	PLANTING & HORTICULTURAL PRACTICES	3	0	0	3

OBJECTIVES:

- Introduction to the characteristics of Plant materials which are an important part of soft landscape, international nomenclature used for plants and their associations in nature.
- To promote understanding of the factors that regulate the growth and characteristics of the plant material.

UNIT I	CHARACTERISTICS OF PLANT MATERIALS	9

Classification of plant kingdom, rules of nomenclature and identification. Plant processes, water relation, mineral nutrition, photosynthesis and respiration. Stem, root and leaf relationship, growth and flowering, response to stimuli and modification. Plant multiplication and adaptation.

UNIT II	FLORISTIC REGIONS OF INDIA	9

Different floristic regions and forest types of India. Dominant, endemic, occasional, prevalent species in select types.

UNIT III	PLANT PROPAGATION	9

Nursery establishment and plant propagation. Establishment and maintenance of grass, shrubs and trees with respect to ground preparation, planting and transplanting, protection of plants during and after planting.

UNIT IV	HORTICULTURAL PRACTICE	9

Plant nutrition and supplements. Fertilizers and Manures- types, methods of applications, advantages and disadvantages. Common plant pests, diseases and their control, insecticides and their application, weed control. Sustainable practices in pest management and weed control. Water budgeting .

UNIT V	LANDSCAPE MAINTENANCE	9

Maintenance methodology, maintenance economics and maintenance details for all soft landscape. Equipment for landscape maintenance.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Knowledge of Binomial nomenclature of plants
CO2	Aspects of Plant growth and propagation, thereby understanding the Maintenance requirement of plants.
CO3	Familiarization with principles and practices of propagation and nursery management for Horticultural Crops.
CO4	Study of introduction to propagation, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras.
CO5	Principle factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.
CO6	Knowledge of nursery management, nursery establishment and nursery rules and regulation.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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	H				M			L				L
	CO3		M		M			L					
	CO4	H					M				M		
	CO5		M					H				L	
3	Category	PC											
4	Approval	30THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA104	SITE PLANNING & DETAILING	1	0	4	3

OBJECTIVES:

- The objective of this course is to equip the students in the techniques of detailing and drawing of Landscape design at site scale.

UNIT I	LANDSCAPE GRAPHICS	5

Symbols of representation of landscape elements in plan, elevation and section.

UNIT II	DESIGN OF LANDFORMS	15

Contours – representation of landforms and landform design, interpolation of contours, slope analysis, uses and function. Grading – symbols and abbreviations, basic grading exercises, grading alignment of paths/roads, angle of repose and use of retaining walls.

UNIT III	EARTHWORK FORMATION	15

Earth works – principles of earth work, cut and fill calculations – borrow pit method, average end area method, average spot level method, precautions taken in cut and fill methods in relation to soil conditions, amount of precipitation etc.,

UNIT IV	HARD LANDSCAPES	20

Design and detail of hard landscapes – Roads, paving, barriers, edge conditions – functions, types, criteria for selection, design aspects, details.

UNIT V	OUTDOOR FURNITURE	20

Criteria for the selection of materials and specifications for the street furniture in various environments. Design of signage and simple outdoor structures like pavilions, gazebos etc.
Use of waste materials in landscape, recycling and reuse of materials, their impact on landscape design. Preparation of working drawings for hard landscaping and services.

TOTAL: 75 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Techniques of drawing landscape and site elements.
CO2	Detailing of site elements like earthwork, hard landscape and outdoor furniture.
CO3	General understanding of climate and elements of micro climate and the relationship to landscape elements.
CO4	To understand site planning process and its significance; establishing relationship between site characteristics and design requirements. Inventory, documentation and site planning checklist
CO5	To understand the issues, involved in micro and macro climate.
CO6	To expose the students on Landscape design in various climate 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
2	CO1		H				M				L		
	CO2	M			M				L				
	CO3		L			L		H					
	CO4	M					M					L	
	CO5		M			M					H		
3	Category	PC											
4	Approval	28THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA105	TRADITIONAL & CONTEMPORARY LANDSCAPE	3	0	0	3

OBJECTIVES:

- To study the social and cultural influences on traditional landscapes through analysis of form and space, siting principles of each period with examples.
- To study contemporary landscape and the manifestation in the western and Indian context.

UNIT I	EASTERN TRADITIONS & ISLAMIC LANDSCAPES	15

Early traditions and beliefs about landscape and environment in east. Ancient Indian traditions – Vedic, Jainism, Buddhism and later Hindu movements. Symbolic meanings and sacred value of natural landscapes. Transfer of concepts through Buddhism to China –Chinese landscape development – gardens of China – Pre Buddhist Japanese landscapes – impact of China on Japanese gardens – Japanese gardens. Nomadic culture of central Asia – advent of Islam – concept of Paradise as a garden – spread of Islamic traditions to the West and East. Eastern expression of Islam – Samarkhand and Mughul India – Tomb and pleasure garden – Moghul concepts of site planning. Western expression of Islam – Spain Alhambra and General life, Granada.

UNIT II	RENNAISSANCE AND THE EVOLUTION OF NEW THOUGHTS	6

Development of the enclosed garden in the Middle ages. Renaissance – Italy, France and England, Romanticism. Influences and linkages across cultures. Study of the western landscapes till the nineteenth century.

UNIT III	THE EVOLUTION OF THE MODERN LANDSCAPE	9

Industrialization and urbanization – impacts and development of the concept of public open spaces, open space development in new towns, parks movement. Open space development and its urban design and planning context, Early industrial towns and the garden city movement. Public park as a major component of urban landscape, the works of F.L.Ohmstead, and other pioneers. Open space development and Close conceptual relationship between Town planning, urban design and landscape architecture. Examples.

UNIT IV	THE MODERN MOVEMENT, CONTEMPORARY CONCEPTS & CONCERNS	9

Changing concepts of space and the relationship of architecture to landscape. Study of selected works of modern architects and landscape architects. Postwar development in Europe. The influence of Ian Mcharg on Landscape architecture. The works of Jellicoe, Burle Marx and others. Concept of sustainable landscape development, Cultural landscapes their definition, identification, characteristics, policies, Artistic sensibility in landscape architecture and land art, New development in urban Landscape design.

UNIT V	INDIAN CONTEXT	6

Issues in contemporary India, Analysis and understanding of philosophies of contemporary landscape works in India, case studies.

TOTAL 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Relationship between culture and Landscape design.
CO2	Perception of open spaces in different cultures.
CO3	To study the social and cultural influences on traditional landscapes through analysis of form and space, siting principles of each period with examples.
CO4	To study contemporary landscape and the manifestation in the western and Indian context.
CO5	Concepts of individuality in visual creations are enriched through the subjects Drawing, Painting and Composition.
CO6	Courses of studies in Sculpture have been planned with emphasis on the creative expression as well as a refinement in a student's development in practical/technical aspects.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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	H			H					M			
	CO3		M				L				L		
	CO4	M			M			H					
	CO5		M			H							L
3	Category	PC											
4	Approval	29THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA1 L1	URBAN LANDSCAPE DESIGN	3	0	0	3

OBJECTIVE:

- To expand the students' knowledge on landscape within urban areas and open spaces in urban context.

UNIT I	INTRODUCTION	6

City and pattern – hierarchy of streets and squares – spatial organization and land use – road networks and basic services. Open spaces with in urban environment.

UNIT II	URBAN SPACES	9

Cultural, social and aesthetic value of urban spaces and its perception, Imageability, Townscape elements. Urban space enhancement.

UNIT III	OPEN SPACE SYSTEM	9

Open space development in urban design context. Evolution of public park as a major component of urban landscape. Open space development in new towns. Park systems, water fronts. Green infrastructure. Urban ecology, urban water sheds.

UNIT IV	ELEMENTS IN URBAN LANDSCAPE	12

Design of public parks, roads, green ways, parkways, promenade and plaza. Public art. Plant selection criteria, furnishings and lighting of public space, maintenance and management of public spaces and parks,

UNIT V	CASE STUDIES	9

Contemporary urban landscape issues. Case studies-Study, understanding and analysis of known examples at the national and international levels.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Types, characteristics and elements of urban open spaces.
CO2	Case studies of urban landscapes.
CO3	To expand the students' knowledge on landscape within urban areas and open spaces in urban context.
CO4	Spatial organization and land use
CO5	Perception, Imageability, Townscape elements.
CO6	Urban space enhancement.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		L				L					H	
	CO3	M			M			H					
	CO4		L				L				M		
	CO5			H					H				M
3	Category	PC											
4	Approval	32NDMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA201	LANDSCAPE CONSTRUCTION	2	0	4	4

OBJECTIVES:

- To train the students in the detailing and drawing of landscape elements and features like lighting, play area, terraces and water features.
- The course discusses the management of water in site through landscape design.

UNIT I	OUTDOOR LIGHTING	10

Definition of technical terms, types of electrical lighting, types of fixtures, auxiliary fixtures. Principles of design for outdoor illumination, design and type of effects with electrical lighting. Safety precautions and drawbacks of electrical lighting, electrical accessories and their installation. Solar energy and lighting.

UNIT II	PLAY AREA AND TERRACE LANDSCAPING	15

Design of play areas -Totlots to play grounds. Design and detail of play equipments. Considerations, design and detail for terrace landscaping, concept of green roof - intensive and extensive.

UNIT III	WATER FEATURES	25

Design of water features such as swimming pools, cascades, fountains etc., and their technical requirements. Consideration for design and detail. Water bodies and natural ponds. Design of irrigation system – landscape area types, objectives and design, water needs and sources, application, methods of installation. Control systems, scheduling and maintenance.

UNIT IV	STORM WATER MANGEMENT	10

Drainage – surface drainage, calculation of surface run off, design of surface and storm water drainage, design of swales and gutters.

UNIT V	WATER RESOURCES PLANNING	15

Water shed and their characteristics, urban storm water drainage systems, protection of natural water bodies, water retention structures, water harvesting techniques and devices.

TOTAL:75 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Detailing and drawing of landscape elements and features.
CO2	Water management through landscape design.
CO3	To train the students in the detailing and drawing of landscape elements and features like lighting, play area, terraces and water features.
CO4	The course discusses the management of water in site through landscape design.
CO5	Principles of design for outdoor illumination, design
CO6	Considerations, design and detail for terrace landscaping

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		M			M					H		
	CO3	L		M			H						
	CO4		M					M					L
	CO5	M				L					M		
3	Category	EEC											
4	Approval	30THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA202	PLANTING DESIGN	3	0	0	3

OBJECTIVES:

- This course discusses in detail about the various aspects of designing plants.
- It also emphasizes on the applications of planting design in the practice.

UNIT I	INTRODUCTION TO PLANTING DESIGN	9

Introduction to planting design. Plants as living materials, landscape architect's view of plants. Plants as structural, functional and decorative elements. Structural characteristics of plants. Spatial functions of plants, ground level planting, below knee height, knee to eye level, above eye level planting, tree planting.

UNIT II	CREATING SPACES WITH PLANTS	9

Experience of spaces, use of planting to manipulate spatial experience, elements of spatial composition – enclosure, dynamics and focus. Plant associations. Plant communities, Designing with canopy layers – 3 layers, 2 layers and single layer. Plants as a part of integral habitats.

UNIT III	VISUAL COMPOSITION IN PLANTING DESIGN	9

Subjective and objective responses to plant material. A study on form, shape, colour, texture, growth characteristics and suitability to different environments. Principles of visual composition-harmony and contrast, Balance, Emphasis, Sequence, Scale, Unity and variety in planting design.

UNIT IV	PLANTING DESIGN FOR HABITAT CREATION	9

Planting strategies and species for various types of habitats – wooded areas, grassland and meadows, wetlands, coastal edges, waterside and aquatic planting, slope retention, and plants for restoration of disturbed habitats.

UNIT V	APPLICATIONS IN PRACTICE	9

Study of local plant materials, their botanical, common and regional names, growth characteristics and application in design. Visit to nurseries. Introduction to soft landscape working drawings, planting plans, specifications and estimation.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	This course discusses in detail about the various aspects of designing plants.
CO2	It also emphasizes on the applications of planting design in the practice.
CO3	Basics of planting design
CO4	Applications of planting design.
CO5	Planting strategies and species for various types of habitats
CO6	Experience of spaces, use of planting to manipulate spatial experience

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		L				L						H
	CO3	M			M				L				
	CO4		H				M						
	CO5	L				L					H		
3	Category	PC											
4	Approval	27THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA203	LANDSCAPE ECOLOGY AND PLANNING	3	0	0	3

OBJECTIVES:

- To understand any developmental activity involves intervention in the natural processes and to minimize the impact due to this intervention.
- To outline the evolution of landscape planning, its premises and the process.

UNIT I	ECOLOGY	9

Understanding the ecosystem and their functioning — components of ecosystem - natural process- Fundamentals of ecology - Ecological processes and dynamics– understanding ecological concepts like population growth, regulation, carrying capacity- colonization and succession-stability and resilience of ecosystem–ecosystem degradation.

UNIT II	LANDSCAPE ECOLOGY	9

Introduction to landscape ecology – formation of various landforms – landforms and landscape process – pattern and structure of landscapes– concepts of patch, corridor and matrix - landscape dynamics and function – topological and chorological process within landscape - concept of landscape metrics – understanding dynamic interaction between landscape structure and function – ecological services of landscape.

UNIT III	LANDSCAPE PLANNING	9

Relationship between man and nature – analytical aspect of landscape - the natural and cultural setting - evolution of landscape planning –concepts and projects of McHarg, Carl Steinite, Warren Manning, Augus Hills, Phil Lewis – Izank Zonneveld, Ervin Zube - landscape planning models – METLAND concept

UNIT IV	PROCESS IN LANDSCAPE PLANNING	9

The purpose of landscape planning – domain and context for landscape planning – principles of planning – procedure in landscape planning - problem defining, goal setting, inventory and analysis - basic of collecting and analyzing, projecting and presenting data in landscape planning, visual assessment and aesthetic dimension.– Suitability analysis – techniques for identifying preferences - Planning options – proposing landscape plan.

UNIT V	CASE STUDIES: LANDSCAPE PLANNING	9

Reclamation and restoration of derelict landscapes - conservation and preservation of ecological fragile areas such as wetlands, creeks etc. - conservation ordinances. Case studies on landscape regional planning - policies and landscape.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Basics of Ecology and Landscape Ecology.
CO2	Landscape planning history, evolution, process and case studies.
CO3	To understand any developmental activity involves intervention in the natural processes and to minimize the impact due to this intervention.
CO4	To outline the evolution of landscape planning, its premises and the process.
CO5	Procedure in landscape planning
CO6	Understanding dynamic interaction between landscape structure and function

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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		M				L						M
	CO3	M			M					L			
	CO4		L			M					H		
	CO5	H					L					M	
3	Category	PC											
4	Approval	28THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA2 L1	LANDSCAPE DESIGN STUDIO-I	0	0	12	6

OBJECTIVE:

- The objective of this course is to introduce the students to Landscape design.

Studio work shall deal with an appreciation of basic landscape design issues and elements – simple site planning, use of plant materials for defining and structuring the open spaces, landscape treatment in relation to the buildings, understanding the aesthetic qualities of the plant materials and their associations.

The studio exercises will involve three or four of the following situations – Campus landscape, Group housing, specialized human landscapes at different situations, parks and garden design. Understanding the function and structuring of outdoor spaces would be the underlying theme.

TOTAL:180 PERIODS

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Landscape Design of small projects primarily involving site planning and design.
CO2	Introduction to Planting design.
CO3	Basic landscape design issues and elements
CO4	Understanding the function and structuring of outdoor spaces
CO5	Landscape treatment in relation to the buildings
CO6	Understanding the aesthetic qualities of the plant materials and their associations.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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						H
	CO3	M		L				L					
	CO4		H				H				M		
	CO5	M				H							
3	Category	EEC											
4	Approval	25THMeeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA301	ENVIRONMENTAL LEGISLATION & EIA	3	0	0	3

OBJECTIVE:

- To familiarize the students to the environmental legislation and its components and it's role in checking the damage to the environment

UNIT I	COMPONENTS OF ENVIRONMENT	6

Environmental sciences, Environment – definition, important components, quality of total environment.

UNIT II	HUMAN IMPACT ON ECOSYSTEMS	12

Environmental impact of man's activities on earth, impacts of agriculture, industrialization, urbanization. Relations between local modification and global phenomena. Green house effect, acid rain etc., Pollution – definition, pollution of air, water, land and noise, effect on humans, vegetation and other life forms, degradation of land. International treaties on environment, sustainable development – ecological and environmental parameters, public participation and role of NGOs. Status of environment in India.

UNIT III	ENVIRONMENTAL LEGISLATION	9

Concept of law constitution in relation to environment. Introduction to town planning legislation and legal tools for development control and their relationship for landscape design objectives. Indian forests acts – preserved, protected, private and village forests, wild life sanctuaries act. Legislative and administrative framework for national parks in U.K., U.S.A. and India. Periphery control legislation and green belt concept. Preservation of the countryside.

UNIT IV	CONSERVATION AND PRESERVATION	9

Legislation relating to preservation of parks, open spaces, playgrounds, trees and ancient monuments. Legislation related to air, water, Land pollution prevention

UNIT V	ENVIRONMENTAL IMPACT ASSESSMENT	9

Environmental impact assessment – definitions, methodologies, techniques, advantages and

disadvantages. Process – data collection, identification of study area, scope, aim, environmental standards and their measurement. EIA in India, legislation related to EIA, EIA in developed and developing countries

TOTAL: 45 PERIODS

OUTCOMES:

- Background and evolution of Environmental legislation.
- The various legislation concerned with the environment.
- EIA and its components

REFERENCES:

1. Michael Allaby, Basics of Environmental Science, Routledge, 2000.
2. Avjit gupta and Mukul.G.Asher, Environment and the developing world, John wiley and sons, Inc, 2000.
3. Larry W.Canter, Environmental Impact Assessment, McGraw – Hill, Inc,1996
4. H.N.Tiwari, Environmental Law, Allahad law agency, 1997.
5. Rosencrany, a.Diwan, Noble.M, Environmental law and policy in India (Cases, Materials, and statutues), Tripathi Bombay, 1991.

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	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
P18PCLA302	RESEARCH METHODOLOGIES IN ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To make the students to distinguish various theoretical ideologies influencing the philosophy and values of architecture.
- To establish the sense of systematic inquiry in students mind to analyze and infer the issues and aspects relating to Architecture.

UNIT I	INTRODUCTION	9

Basic research issues and concepts- orientation to research process- types of research: historical, qualitative, co-relational, experimental, simulation and modeling, logical argumentation, case study and mixed methods- illustration using research sample.

UNIT II	RESEARCH PROCESS	9

Elements of Research process: finding a topic- writing an introduction- stating a purpose of study- identifying key research questions and hypotheses- reviewing literature- using theory- defining, delimiting and stating the significance of the study, advanced methods and procedures for data collection and analysis- illustration using research samples

UNIT III	RESEARCHING AND DATA COLLECTION	9

Library and archives- Internet: New information and the role of internet; finding and evaluating sources- misuse- test for reliability- ethics Methods of data collection- From primary sources: observation and recording, interviews structured and unstructured, questionnaire, open ended and close ended questions and the advantages, sampling- Problems encountered in collecting data from secondary sources-

UNIT IV	REPORT WRITING	6

Research writing in general- Components: referencing- writing the bibliography- developing the outline- presentation; etc.

UNIT V	CASE STUDIES	12

Case studies illustrating how good research can be used from project inception to completion- review of research publications

TOTAL: 45 PERIODS

OUTCOMES:

- The student will develop the skill to identify, decipher and interpret the issues relating to Architecture, based on research enquiry methods.
- The student will widen the information and will prepare the students for scientific method of researching and research process.

REFERENCES:

1. Linda Groat and David Wang; Architectural Research Methods;
2. Wayne C Booth; Joseph M Williams; Gregory G. Colomb; The Craft of Research, 2nd Edition; Chicago guides to writing, editing and publishing;
3. Iain Borden and Kaaterina Ruedi; The Dissertation: An Architecture Student's Handbook; Architectural Press; 2000
4. Ranjith Kumar; Research Mehodology- A step by step guide for beginners; Sage Publications; 2005
5. John W Creswell; Research design: Qualitative, Quantitative and Mixed Methods Approaches; Sage Publications; 2002

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce methods and process of research, in order to understand the significance of the same with reference to landscape architecture and to develop skills of conducting and communicating research.
CO2	Introduction to research: Types of research and the process of formulating a research Project and their applications
CO3	Research Methods: Various methods of research, their relative advantages and disadvantages
CO4	Research Writing: Introduction to technical writing and presenting a research paper
CO5	Research Publication: Introduction to various form of publication of research
C06	Cyber security and laws related to the same. Plagiarism in research: Introduction to the concept, Problem of plagiarism & software to check the same

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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
P18PCLA3L1	ADVANCED LANDSCAPE DESIGN STUDIO– II	0	0	12	6

OBJECTIVE:

- The objective of this course is to train students in advanced landscape design involving complex situations that require handling of multiple information and contexts.
- The studio exercises will involve three or four of the following situations – urban context, historical landscape, specialized landscape situations, industrial landscapes, recreational landscapes. Understanding of ecologically sustainable development would be the underlying theme.

TOTAL:180 PERIODS

OUTCOME:

- Training in advanced Landscape design.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand site context and to resolve complex landscape issues in urban and rural fabric, dealing with residential / commercial / institutional / recreational land use in relation to landform, vegetation & water
CO2	Documentation & Mapping, Analysis, Synthesis, Suitability, Zoning and planning with landscape land uses (for medium to large scale projects
CO3	Evolving landscape structure for sites & suggesting an appropriate landscape design with respect to ecological, functional, cultural & visual context.
CO4	Process of landscape project formulation and landscape design development/planning in response to contextual analysis, synthesis & theoretical bearings
CO5	Students will work on above mentioned in detail and will submit the work in the form of drawings and/ models
C06	To resolve complex landscape issues in urban and rural fabric with landscape design and Planning & To be able to derive an open space structure for the site/zone with suitable landuses/activities in response to the 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
P18PCLA3L2	DISSERTATION	0	0	6	3

OBJECTIVE:

- To promote research in Landscape architecture. In addition this course will also train the students in collecting, critically analyzing and presenting information in a logical sequence.Topics related to various aspects of Landscape Architecture could be chosen in consultation with faculty members, comprehensively researched and findings presented in a series of seminars by individual students. The materials would be documented and formally presented as a dissertation at the end of the semester.

TOTAL: 90 PERIODS

OUTCOMES:

- Research on a chosen topic.
- Expertise in collecting, processing and presenting relevant information.
- On the successful completion of the course, students will be able to

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Develop the skill to identify, decipher and interpret issues relating to architecture based on research enquiry methods**.**
CO2	Understand CO2 Analyse different methods of conducting research and research writing.
CO3	Redefine a social Problem into a Research Problem,generate a methodology to prove it and convert it into technical /Popular Reports.
CO4	Apply,Analyse and Create Course Level Assessment Questions
CO5	Enumerate the types of Research and Illustrate with examples. & Discuss the Research Process in detail.
C06	Analyse different methods of conducting Research and suggest a suitable method for a particular Research & Discuss in detail the criteria for selecting a sampling procedure.

Mapping of Course Outcomes with Program Outcomes (POs) (H/M/L indicates strength of 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	M	
	C06				M				L				
3	Category	Professional Core(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PCLA401	PROFESSIONAL PRACTICE OF LANDSCAPE ARCHITECTURE	3	0	0	3

OBJECTIVE:

- The objective of this course is to educate the students on the various aspects of a Landscape design practice.
-

UNIT I	THE PROFESSION OF LANDSCAPE ARCHITECTURE	6

Brief history of profession, Professional career tracks, Registration and License, professional ethics and code of professional conduct.

UNIT II	PRINCIPLES OF PROFESSIONAL PRACTICE	9

The client- different kinds of clients and projects, general concept for engaging the services of landscape architect. The extent and variety of services performed by landscape architect, terms and conditions.

UNIT III	PROFESSIONAL RELATIONSHIPS	9

Interface with other consultants and contracting agencies. Prime consulting, Multiple direct-consulting, Sub consulting relationships. Relationship between the Landscape architect and Clients, Allied professional, contractor, General public.

UNIT IV	PROFESSIONAL APPROACH	12

Methods of working – surveys, preparation of policy and design proposals. Reports, contents and production techniques. Types and contents of Drawings prepared in a landscape architect's office. Contracts- Definition and terminologies, Contract documents. Preparation of tender documents. Different types of tender.

UNIT V	PROJECT MANAGEMENT	9

Planning, and organizing the project. PERT and CPM. Project supervision, co- ordination between different agencies, Monitoring a project during execution and preparation of site reports.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge about landscape consultancy practice**.**
- Information about the profession.

REFERENCES:

1. Walter Rogers, The Professional practice of landscape architecture, Van nostrand Reinhold, 1997.
2. John.L.Motloch, Introduction to Landscape design, 2001.
3. Jack.E.Ingels, Landscaping, Principles and Practices, Delmar publishersinc, 1992.
4. W.F.Hill, Landscape handbook of Tropical Landscape, Garden Art Press, 1995.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	to obtain knowledge of basic concepts, methods, and applications in Professional career and Professional conduct.
CO2	to examine and understand the ways in which Professional ethics
CO3	Spatial processes operate in an ecological context
CO4	to learn and become familiar with the techniques used by landscape architects in their work
CO5	to understand the relevance of landscape ecology to human society
C06	to apply the concepts, models, and techniques in landscape ecology in natural resources management & Project 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	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
P18PCLA4L1	THESIS	0	0	22	11

OBJECTIVE:

- The objective of this course is to train the students to work individually on projects.

Thesis will be an individual project dealing with complex problems of landscape architecture including site planning and landscape planning and seeks to develop concepts of landscape design as an interactive process of natural and man-made environment.

TOTAL:330 PERIODS

OUTCOME:

Thesis will be an individual project dealing with landscape architecture including development of particular interested areas concepts of landscape design as an interactive process of natural and man-made environment.

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.
C06	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	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
P18PELA001	APPLICATION OF GIS IN LANDSCAPE DESIGN	3	0	0	3

OBJECTIVES:

- GIS is being increasingly used worldwide for landscape planning and restoration projects.
- The objective of the course is to train the students in the application of GIS in Landscape design.

UNIT I INTRODUCTION 6

Classification of Spatial and non-spatial data - spatial relationships among elements / activities – fundamentals of topological relationship - spatial data and their representation in maps - raster and vector based system to representing spatial objects
- objective and functions Geographical Information System – GIS software in general - over view of GIS map components.

UNIT II MAP PREPARATION AND DISPLAYING 12

Basics of GIS maps preparation – digitization of spatial data - concept of point, line and polygon features - fundamental of coordinate system – map layers and geo- referencing – displaying spatial features – adding attribute values to the features – preparing and displaying thematic layers and maps - selecting and editing spatial features and attribute data - preparing Grid surfaces form point, line and polygon features.

UNIT III SPATIAL ANALYSIS USING GIS 9

Spatial joining - concept of geo processing – union, intersect, clip and merge – features to raster - preparing surfaces - creating TIN surfaces and contours - surface analysis – spatial joining of geographic features.

UNIT IV APPLICATIONS OF GIS IN LANDSCAPE ARCHITECTURE 6

Overlaying features and analyzing using overlay function – feature selection – buffering
– table joining and analysis - manipulating attribute data – classification and reclassifications - GIS modeling – 3D display.

UNIT V LANDSCAPE PLANNING AND GIS 12

Introduction to landscape GIS model - Case problem on landscape analysis – suitability analysis using GIS – preparing land-use maps – landscape impact analysis using GIS - landscape suitability analysis – application of GIS in assessing Landscape Ecological risks.

TOTAL: 45 PERIODS

REFERENCES:

1. Brail K.R (1990) Integrating GIS into Urban Regional Planning, Alternative approaches for developing countries, regional development Dialogue, Vol.11, No.3 UNCRD, Japan, 1990.
2. Karen C.Hanna, GIS for Landscape Architects, ESRI press, 1999.
3. Andy Mitchell, GIS Analysis Volume 1. Geographic patterns and Relationships, ESRI Press 2005.
4. David Maquire and Michael Batty (Editors) GIS, Spatial Analysis and Modeling, ESRI Press, 2005.
5. Cynthia A. Brewer, Designing Better Maps: A Guide for GIS Users, ESRI Press

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce the principles of aerial and satellite based remote sensing for studying earth resources.
CO2	To introduce geophysical well logging techniques for interpretation of subsurface geology
CO3	well logging, classification of well logging methods, formation evaluation and its importance.
CO4	Basic principles, SP log, normal and lateral logs, focused logs, micro resistivity tools and their role in formation evaluation; Applications.
CO5	Basic principles of different types of radiation logs including gamma ray, gamma-gamma, neutron thermal and chlorine logs; Porosity determination and cross plots; Applications
C06	Permeability, bound and free-water estimation using NMR logging techniques; Applications Caliper, dip meter, cement bond logging, casing collar locators, temperature logging; 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		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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA002	COMPUTER APPLICATIONS AND MANAGEMENT INFORMATION SYSTEMS	3	0	0	3

UNIT I INTRODUCTION 9

The use of computer software (Photo-Shop and Illustrator) for the processing of words and images. Issues, ideas, themes of representation and imaging in digital media using some of graphic material.

UNIT II APPLICATION OF COMPUTERS IN THE DESIGN PROCESS 9

Various projection and graphic techniques. Developing skills in visualization and eidetic representation using the computer as tool for developing design projects. Advanced work with Photo-Shop and Illustrator, and in particular techniques with AutoCAD.

UNIT III COMPUTERS AND DESIGN PRESENTAIONS 9

Means for integration of fundamentals and techniques. The interactive realm of 3D modeling and animation using primarily FORM-Z modeling programs.

UNIT IV NON LINEAR PRESENTATION (FLASH AND DIRECTOR) 9

Importing files using standard and linking options. Using scripts and behaviors, understanding stage, cast and time line, using cast library, Tweening, using swf movie, presentation using voice over and presentation demos, creating auto run cd roms.

UNIT V CASE STUDIES 9

Exploring the various design media as they relate to form, image, sequence, movement, and animation through a series of weekly exercises.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge about computer software that can be used for presentations
- Application of these programs in producing their design presentations.

REFERENCES:

1. J.Jeffcoate, Multimedia in Practise: Technology and Applications, Prentice hall, New jersey, 1994.
2. Apple computer Inc., Multimedia demystified – a guide to the world of multimedia, Random house, New Media, Newyork, 1994.
3. Kirk, Ross and Hunt, Andy, Digital Sound Processing for music and multimedia, Focal press, Oxford, 1999.
4. S.Robert Tannenbaum, Theoretical foundations of Multimedia, Computer Science Press, Newyork, 1998.
5. Mark Von Wodtke, Mind over media: creative thinking skills for electronic media, McGraw hill, Newyork, 1993

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce the principles of Software like AutoCAD
CO2	To introduce Software – Photoshop and illustrator
CO3	well logging, classification of well logging methods, formation evaluation and its Importance.
CO4	Basic principles, standard and linking options. Using scripts and behaviors, understanding stage, cast and time line, using cast library
CO5	Basic principles of different types voice over presentations
C06	Case study of form image and sequence movement and animation

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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
P18PELA003	LANDSCAPE MANAGEMENT	3	0	0	3

OBJECTIVES:

- To introduce the students to Landscape management is an integral part of Landscape planning and design
- This course elaborates on the various techniques for assessment and valuation of natural resources and their management.

UNIT I INTRODUCTION 9

Fundamentals and concepts in Environmental Economics– Ecosystem Services and Valuation - natural capitals and their benefits to the society– externalities and public goods – non renewable resource depletion and their social costs - intangible cost associated with social and cultural changes – Economics of global climate change – Kyoto protocol – pollution control and Carbon trading - Economic definitions of sustainability - Ecological vs. Economic sustainability.

UNIT II ENVIRONMENTAL ECONOMICS IN LANDSCAPE 9

Valuation of landscape services– measuring benefits and cost- tangible costs of landscape development, capital and maintenance cost - modification of natural system and environmental costs.

UNIT III LANDSCAPE ASSESSMENT 9

Assessing the landscape value – landscape quality – aesthetic, heritage and sensitivity values. –

Landscape Perception - Evaluating natural process, pattern and elements of landscape. Classification and ranking of landscape. Basic quantitative methods of collecting and analyzing, projecting and presenting data for landscape planning, visual assessment and aesthetic dimension.

UNIT IV MODELS IN LANDSCAPE ASSESSMENT 9

Models for assessing landscape resources – land use impact assessment models – model to assess the ecological values – Land Evolution and Site Assessment model (LESA) – Ecological modeling – GIS models in landscape assessment.

UNIT V MANAGEMENT 9

Landscape management at the regional scale in relation to soil conservation. Land use planning and resource management - water management, forest management, grassland and agricultural management. Management practice related to urban ecology and urban habitats such as urban forests, urban water sheds, regional parks, green belts. Ecological. Economic and administrative issues, management models.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge of Landscape Assessment techniques and valuation of natural resources.
- Case studies of Landscape management.

REFERENCES:

1. Conrad, J. M. (1999). Resource Economics. Cambridge University Press. Field, B. C. and Field, M. K. (2006). Environmental economics. McGraw-Hill/Irwin.
2. Hanley, N., Shogren, J. F., and White, B. (1997). Environmental economics in theory and practice. Oxford university press, New York.
3. Kolstad, C. D. (2003). Environmental economics. Oxford university press.
4. Solow, R. M. (1993). An almost practical step toward sustainability. Resources policy, 19(3):162–172.
5. Varian, H. R. (2007). Intermediate microeconomics: A modern approach. W. W. Norton & Company.
6. Daly, H. E. and Farley, J. Ecological Economics: Principles and Applications. Washington, D.C.: Island Press, 2004.

7. COURSE OUTCOMES (COs)													
The student will be able													
CO1	To learn Landscape management is an integral part.												
CO2	Understand the Landscape planning and design.												
CO3	Execute the various techniques for assessment.												
CO4	Analyze the valuation of natural resources.												
CO5	Evaluate the resources and their management.												
C06	To understand the economics and ecological 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	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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA004	GIS MODELLING IN URBAN PLANNING	3	0	0	3

OBJECTIVES:

- GIS is being increasingly used worldwide for landscape planning and restoration projects.
- The objective of the course is to train the students in the application of GIS in Landscape design.

UNIT I INTRODUCTION 6

Classification of Spatial and non-spatial data - spatial relationships among elements / activities – fundamentals of topological relationship - spatial data and their representation in maps - raster and vector based system to representing spatial objects
- objective and functions Geographical Information System – GIS software in general - over view of GIS map components.

UNIT II MAP PREPARATION AND DISPLAYING 12

Basics of GIS maps preparation – digitization of spatial data - concept of point, line and polygon features - fundamental of coordinate system – map layers and geo- referencing – displaying spatial features – adding attribute values to the features – preparing and displaying thematic layers and maps - selecting and editing spatial features and attribute data - preparing Grid surfaces form point, line and polygon features.

UNIT III SPATIAL ANALYSIS USING GIS 9

Spatial joining - concept of geo processing – union, intersect, clip and merge – features to raster - preparing surfaces - creating TIN surfaces and contours - surface analysis – spatial joining of geographic features.

UNIT IV APPLICATIONS OF GIS IN LANDSCAPE ARCHITECTURE 6

Overlaying features and analyzing using overlay function – feature selection – buffering – table joining and analysis - manipulating attribute data – classification and reclassifications - GIS modeling – 3D display.

UNIT V LANDSCAPE PLANNING AND GIS 12

Introduction to landscape GIS model - Case problem on landscape analysis – suitability analysis using GIS – preparing land-use maps – landscape impact analysis using GIS - landscape suitability analysis – application of GIS in assessing Landscape Ecological risks.

TOTAL: 45 PERIODS

REFERENCES:

6. Brail K.R (1990) Integrating GIS into Urban Regional Planning, Alternative approaches for developing countries, regional development Dialogue, Vol.11, No.3 UNCRD, Japan, 1990.
7. Karen C.Hanna, GIS for Landscape Architects, ESRI press, 1999.
8. Andy Mitchell, GIS Analysis Volume 1. Geographic patterns and Relationships, ESRI Press 2005.
9. David Maquire and Michael Batty (Editors) GIS, Spatial Analysis and Modeling, ESRI Press, 2005.
10. Cynthia A. Brewer, Designing Better Maps: A Guide for GIS Users, ESRI Press

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To introduce the principles of aerial and satellite based remote sensing for studying earth resources.
CO2	To introduce geophysical well logging techniques for interpretation of subsurface geology
CO3	well logging, classification of well logging methods, formation evaluation and its importance.
CO4	Basic principles, SP log, normal and lateral logs, focused logs, micro resistivity tools and their role in formation evaluation; Applications.
CO5	Basic principles of different types of radiation logs including gamma ray, gamma-gamma, neutron thermal and chlorine logs; Porosity determination and cross plots; Applications
C06	Permeability, bound and free-water estimation using NMR logging techniques; Applications Caliper, dip meter, cement bond logging, casing collar locators, temperature logging; 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		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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA005	CONTEMPORARY PROCESES IN ARCHITECTUREDESIGN	3	0	0	3

OBJECTIVES:

- To investigate the contemporary theories of media and their influence on the perception of space and architecture.
- To provide an overview of various contemporary design processes and its relation to computation.

UNIT I INTRODUCTION 6

Investigation of contemporary theories of media and their influence on the perception of space and architecture. Technology and Art – Technology and Architecture – Technology as Rhetoric – Digital Technology and Architecture

UNIT IIASPECT OF DIGITAL ARCHITECTURE 9

Aspects of Digital Architecture – Design and Computation – Difference between Digital Process and Non-Digital Process – Architecture and Cyber Space – Qualities of the new space – Issues of Aesthetics and Authorship of Design – Increased Automatism and its influence on Architectural Form and Space

UNIT IIICONTEMPORARY PROCESS 12

Overview of various Contemporary design process and it relation to computation: Diagrams – Diagrammatic Reasoning – Diagrams and Design Process – Animation and Design – Digital Hybrid Design Protocols – Concept of Emergence - Introduction to Cellular Automata and Architectural applications – Genetic algorithms and Design Computation

UNIT IVGEOMETRIES AND SURFACES 12

Fractal Geometry and their properties – Architectural applications - Works of Zvi Hecker – Shape Grammar - Shapes, rules and Label - Shape Grammar as analytical and synthetic tools- Combining Shape grammar and Genetic algorithm to optimize architectural solutions - Hyper Surface– Introduction to Hyper surface and concepts of Liquid architecture.

UNIT V CASE STUDIES 6

Case studies- Study, understanding and analysis of known examples at the national and international levels which demonstrates the contemporary theories of media and their influence on the perception of space and architecture, contemporary design processes and its relation to computation.

TOTAL:45 PERIODS

REFERENCES:

1. Peter Eisenmann, Diagram: An Original Scene of Writing, Diagram Diaries
2. MOVE, UN Studio
3. Grey Lynn, The Folded, The Pliant and The Supple, Animate form
4. Contemporary Techniques in Architecture, Halsted Press, 2002
5. Ali Rahim, Contemporary Process in Architecture, John Wiley & Sons, 2000.
6. Walter Benjamin, Practices of Art in the Age of Mechanical Reproduction Colin press, 1977
7. Work of Architecture in the Age of Mechanical Reproduction, Differences MIT press,1997.
8. William J Mitchell, the Logic of Architecture: Design, Computation and Cognition. MIT Press, Cambridge, 1995
9. Marcos Novak, invisible Architecture: An Installation for the Greek Pavilion, Venice Biennale, 2000.

10. COURSE OUTCOMES (COs)	
The student will be able	
CO1	To impart knowledge of computer and GIS applications in Landscape architecture and planning projects.
CO2	To understand and Application of software such as Revit Architecture Suite including building information modeling (BIM) and 3D Max.
CO3	To understand and Application of Presentation software: Photoshop, coral draw, etc
CO4	To understand and Application of software such as Sketchup, Podium and E-view.
CO5	To understand and Application of software such as Catia, Primavera for construction planning management.
C06	To understand and Application of software such as Design Builders and other software related to energy simulation modeling.

Mapping of Course Outcomes with Program Outcomes (POs)
(H/M/L indicates strength of 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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA006	ARCHITECTURE AND CRITICAL THEORY	3	0	0	3

OBJECTIVES:

- To introduce the idea of architecture as enmeshed in the society and a product of larger socio-cultural issues and practices, and not as an autonomous object determined by a hermetically sealed discipline.
- To introduce the various interdisciplinary critical theories and explain their interpretation of architecture.

UNIT I INTRODUCTION 6

Definition of theory - Architectural theory and its nature, purpose and its relation to practice - overview of some traditional architectural theories- context for the rise of more critical theories in architecture – Introduction to Critical Theory- Architecture and Critical Theory.

UNIT II POWER AND BUILT ENVIRONMENT 10

Definition of power- Forms of power- Power in the built environment at various scales- ideas of power and society, power-knowledge- Colonialism in India as a form of dominance- introduction to architecture and urbanism of colonialism in India- Production of Indo-Saracenic architecture- New Delhi as a part of imperial vision - Case studies of the architecture and urbanism of power in the modern world.

UNIT III PLACEAND ARCHITECTURE 10

Critical reactions to modernity/ modernism with reference to the concept of context/ place- Critical Regionalism and architectures of resistance- Place and phenomenology in architecture

UNIT IV SEMIOTICS AND ARCHITECTURE 10

Architecture as communication and representation- introduction to linguistic concepts of semiotics, structuralism, post structuralism and deconstruction- brief over view of postmodern and deconstructivist architecture with reference to these concepts

UNIT VCONTEMPORARY ISSUES IN ARCHITECTURE 9

Conditions of late capitalism and postmodern society- Society of spectacle- Architecture as spectacle and seduction- Theme parks and shopping malls- privatisation of public spaces- aesthetisation of architectural issues- influence of globalisation and digital revolution on architectural processes- debates of heritage- gender and space

OUTCOMES:

- The students would gain an understanding of architecture as an integral production of society as well as engage in critical thinking to interpret architecture.
- The students' awareness through this course would inform their practice/ research

REFERENCES:

1. Neil Leach (ed) Rethinking Architecture, Routledge 2000
2. Michael Hays (ed) Architectural Theory since 1960,MIT Press, 2000
3. Kate Nesbitt, Theorizing a New Agenda for Architecture, Princeton Architectural Press, 1996
4. Anthony D. King, Colonial Urban Development, Routledge & Paul, London, 1976
5. Thomas Metcalf Imperial vision, Oxford, 2002
6. Jane Rendell, Barbara Penner, Iain Borden, Gender Space Architecture, Routledge, 2000
7. Kim Dovey, Framing Places: Mediating Power in Built Form, Routledge 1999.
8. Neil Leach, Anaesthetics of Architecture, MIT Press 1999,
9. Guy Debord. Society of Spectacle,Ian Borden & Jane Rendell,(ed), Intersections, Routledge 2000
10. Paul Allan Johnson,Theory of Architecture, Routledge 2000
11. Christian Norberg Schulz- Towards a Phenomenology of Architecture, Rizzoli New York, 1980

COURSE OUTCOMES (COs)	
The student will be able	
CO1	Understanding of the effect of contemporary theories of media on contemporary architectural design.
CO2	Understand the Increased Automatism and its influence on Architectural Form and Space
CO3	Understand the methods of computation Design and diagrammatic representations
CO4	Application of various concepts of process of digital architecture design
CO5	Understanding of various contemporary design process and their relation to computation
C06	To understand the architectural issues and architectural 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	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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA007	WEB DESIGN AND PORTFOLIO PRODUCTION	3	0	0	3

UNIT I INTRODUCTION TO WEB DESIGN 15

Basics of web design – Introduction to software used for web design – ADOBE IMAGE READY, DREAMWEAVER, FLASH etc.

UNIT II STATIC PAGES 15

Slice – URL in ADOBE IMAGEREADY. Creation and Editing of site map – layer, tables, frameset, - CSS style – Forms – tools like insert, roll over etc., in DREAMWEAVER

UNIT III ANIMATION IN FLASH 15

Introduction to MACROMEDIA FLASH, importing other file formats to Flash- saving and exporting Flash files, Frame by frame animation – Motion Tweening – Shape Tweening

UNIT IV INTRODUCTION TO SCRIPTING 15

Using Timeline – Frames –Key frames- Creating and using Symbols- Simple scripting in flash – Publishing SWF files

UNIT V DEVELOPING A WEB SITE30

Using the skills and concepts learnt with the ADOBE IMAGEREADY, DREAMWEAVER, FLASH softwares . students will develop their portfolio in the form of web pages. These pages have to be uploaded in free public domains.

TOTAL: 90 PERIODS

REQUIRED READING

1. Photoshop 7 Bible Professional Edition, Wiley John & Son INC, New York.
2. Flash Web Design, The Art of Motion Graph, Curtis Hillman, New Riders Publishing, Indianapolis, IN. U.S.A, 2000
3. M.E. Morris, and R.J. Hinrichs, Web Page Design, Prentice Hall, 1996.
4. Mark Von Wodtke, Mind over Media : Creative Thinking Skills for Electronic Media, McGraw-hill, New York, 1993
5. Adobe Flash CS3 professional on demand by Steve Johnson, Andy Anderson, Perspection inc, 2012.

REFERENCES

1. Adobe Photoshop CS3 studio techniques, Ben Wilmore, 2012.
2. Adobe Dreamweaver CS6 classroom in a book, Adobe creative team, 2012.

COURSE OUTCOMES (COs)	
The student will be able	
CO1	To understand Basics of web design,Introduction to software used for web design
CO2	To understand the Creation and Editing of site map layer, tables, frameset, CSS style tools like insert, roll over etc
CO3	Introduction to macromedia flash, importing other file formats to Flash- saving and exporting Flash files, Frame by frame animation
CO4	Using Timeline ,Frames ,Key frames, Creating and using Symbols Simple scripting in flash
CO5	Using the skills and concepts learnt with the adobe image ready, dream weaver, flash software's. Students will develop their portfolio in the form of web pages. These pages have to be uploaded in free public domains.
C06	To implement with the web design and to prepare a model in 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	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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

COURSE CODE	COURSE TITLE	L	T	P/S	C
P18PELA008	SUSTAINABILITY AND ENERGY CONSERVATION IN LANDSCAPE ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To expose the students on the issues of sustainability at the global level.
- To focus on the energy conservation landscape and sustainability at the micro level.
- Sustainable landscape design for various climates of India

UNIT I INTRODUCTION TO SUSTAINABILITY 10

Need and concept of sustainability, Brundtland report, World Commission on environment and development, sustainable development, sustainable growth, sustainable economy and sustainable use. Visions of sustainability. Source and ethics of sustainability. Sustainability and Climate Change.

UNIT II SUSTAINABLE SITE 7

Sustainable site – LEEDS, BREAM, rating erosion and sedimentation control, site selection, urban development, landscape and exterior design etc., Green Building in the context of sustainability. Ecology and sustainability. Eco-City.

UNIT III INTRODUCTION TO ENERGY CONSERVATION IN LANDSCAPE9

Energy conservation and sustainability, principles of energy systems, energy and global environment, scope for energy conservation in landscape.

UNIT IV ENERGY CONSERVATION METHODS IN LANDSCAPE ARCHITECTURE-CASE STUDIES 10

Various methods of energy conservation in landscape architecture, energy conservation techniques in various climates- hot and humid, hot dry, etc. Energy efficient site planning and landscape development. Energy efficient planting design. .

UNIT V SUSTAINABLE LANDSCAPE PRACTICES 9

Sustainable landscape maintenance and management, Sustainable planning and city form. Sustainable urban landscape, landscape sustainability at the national and regional level.

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding of sustainability from macro to micro level.
- Knowledge on Energy conscious Landscape design

REFERENCES:

1. John.F.Benson and Maggie.H.Roe, Landscape and sustainability, John Wiley Publication, New York, 2000.
2. O.R.Gray, Landscape Planning for Energy Conservation,
3. Anne Simon Moffat and Marc Schiller, Landscape design that saves energy, William Monow and co.,Inc., New York, 1981.
4. Publications of Centre for science and environments, TERI, New Delhi

5.	**COURSE OUTCOMES (COs)**
The student will be able	
CO1	To make aware of the Sustainable design aspects for landscape and Green buildings design concepts.
CO2	Introduction to sustainable development in relation to natural resource conservation energy conservation, environmental pollution and conservation of bio-diversity
CO3	Global issues such as global warming, ozone layer depletion, green house gases and depletion of natural resources in relation to energy generation;
CO4	Sustainable development from the perspective of regional and urban planning; Issues at regional and micro level;
CO5	Climate considerations in design of buildings in various climates;
C06	Eco-friendly 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		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 Elective(PC)											
4	Approval	32nd Meeting of Academic Council											

CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

M.Tech – INDUSTRIAL BIOTECHNOLOGY

I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18 PCBT101	PC	Advanced Biochemistry	3	3	0	0	3
2	P18PCBT102	PC	Plant and Animal Biotechnology	3	3	0	0	3
3		PE	Professional Elective I	3	3	0	0	3
4		PE	Professional Elective II	3	3	0	0	3
5	P18PRBT 101	PR	Bio Research Methodology and IPR	2	2	0	0	2
6		AC	Audit Course I	2	2	0	0	0
PRACTICAL								
7	P18PCBT1L1	PC	Biochemistry and Microbiology Lab	4	0	0	4	2
8	P18PCBT1L2	PC	Plant and Animal Biotechnology Lab	4	0	0	4	2
Total				24	16	0	8	**18**

SEMESTER II								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCBT201	PC	Downstream Processing	3	3	0	0	3
2	P18PCBT 202	PC	Bioprocess engineering and plant design	3	3	0	0	3
3		PE	Professional Elective III	3	3	0	0	3
4		PE	Professional Elective IV	3	3	0	0	3

5		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCBT2L1	PC	Bioprocess engineering Lab	4	0	0	4	2
7	P18PCBT2L2	PC	Downstream Processing Lab	4	0	0	4	2
8	P18PRBT2P1	PR	Mini Project with Seminar	4	0	0	4	2
Total				26	14	0	12	**18**

SEMESTER III								
S.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRBT3P1	PR	Dissertation-Phase I	14	0	0	20	10
			Total	20	6	0	20	**16**

SEMESTER IV								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRBT4P1	PR	Dissertation-Phase II	28	0	0	32	16
			Total	28	0	0	32	**16**

TOTAL CREDITS: 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE - 1								
S.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**

1	P18PEBT011	PE	Industrial Microbiology and Fermentation Technology	3	3	0	0	3
2	P18PEBT012	PE	Enzyme Engineering	3	3	0	0	3
3	P18PEBT013	PE	Environmental Biotechnology	3	3	0	0	3

PROFESSIONAL ELECTIVE - 2

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT021	PE	Principles of Process Engineering	3	3	0	0	3
2	P18PEBT022	PE	Dairy Technology	3	3	0	0	3
3	P18PEBT023	PE	Cancer biology	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT031	PE	Recombinant DNA technology	3	3	0	0	3
2	P18PEBT032	PE	Nanobiotechnology	3	3	0	0	3
3	P18PEBT033	PE	Immunotechnology	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT1041	PE	Stem cell and Tissue Engineering	3	3	0	0	3
2	P18PEBT042	PE	Food Process Engineering	3	3	0	0	3
3	P18PEBT043	PE	Biopharmaceutical Technology	3	3	0	0	3

PROFESSIONAL ELECTIVE - 5

Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT051	PE	Proteogenomics and Bioinformatics	3	3	0	0	3

2	P18PEBT052	PE	Bioreactor Design	3	3	0	0	3
3	P18PEBT053	PE	Industrial Safety Engineering	3	3	0	0	3

OPEN ELECTIVES

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

AUDIT COURSES I & II

S.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

P18PCBT101	**ADVANCED BIOCHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: General biochemistry				
	Course Designed by : Department of Industrial Biotechnology				

OBJECTIVES: To provide a knowledge of biochemical components and its functions and their applications from the perspective of engineers

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of carbohydrates and lipids, their classification, struc and functions
CO2	to apply the basic concept of, proteins and nucleic acids
CO3	to get an idea about photosynthesis and its mechanism
CO4	to know about enzymes and its applications
CO5	to get a basic knowledge of hormones

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

1	COs/Pos	A	B	c	d	e
2	CO1	H	H	H		
	CO2	H		H		M
	CO3		M		H	
	CO4	H		M	L	
	CO5		M			H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I BIOMOLECULES I **9**

Carbohydrates: structure, classification, Biological role, metabolism- glycogenesis, glycogenolysis- gluconogenesis- glycolysis- Kreb cycle- HMP shunt pathway.

Lipids: classification, structure, functions, metabolism, biosynthesis and degradation (β-oxidation) of fatty acids and cholesterol biosynthesis-biological role of cholesterol derivatives.

UNIT II BIOMOLECULES II **9**

Proteins: building locks of proteins- classification and properties- classification, biological functions and structure of proteins, protein denaturation-protein oxidation –urea cycle.

Nucleic acids: purine and pyrimidine nucleotides- structure and biosynthesis- DNA double helical structure and its biological significance.

UNIT III BIOENERGETICS OF PHOTOSYNTHESIS AND RESPIRATION 9

Photosynthesis: raw materials, photosystem I and II, mechanism, light and dark reaction, photophosphorylation.

Respiration: oxidative phosphorylation- bioenergetics of respiration with reference to glucose- high energy compounds and free energy change of hydrolysis.

UNIT IV ENZYMES 9

Nomenclature and classification- active site- mode of action- enzyme kinetics- factors affecting enzyme activity- Michaelis- Menten equation- Line Weaver Burk representation- enzyme inhibition (reversible and irreversible) kinetics.

UNIT V HORMONES 9

Endocrine system, an overview - fat soluble hormones: structure, biosynthesis, function and general mode of action of thyroid and steroid hormones- Water soluble hormones: hypothalamic, pituitary and pancreatic hormones, biological role, signal transduction and secondary messenger system.

TEXT BOOK

1. 'Glaw A, 2008, "Clinical biochemistry" Elsevier Health Sciences, 4th edition.
2. J.L. Jain, 2004, "Fundamentals of biochemistry" S. Chand.

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

P18PCBT102	**PLANT AND ANIMAL BIOTECHNOLOGY**			**L**	**T**	**P**	**C**
	Total Contact Hours: 45			**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Biotechnology, Genetic engineering						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic knowledge about plant and animal tissue culture and its applications							
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 understand the fundamentals of animal cells and culture						
CO4	to know the large scale of cell cultures in a bioreactor						
CO5	to get a basic knowledge of the applications of animal cell in biological systems and 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	
2	CO1	H	H	H			
	CO2	M		H	L	M	

	CO3	H	M		H	L
	CO4	M		M	L	
	CO5	H	M			H
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
		√				
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION 9

Biotechnology: Definition and scope- global impact of biotechnology in agriculture, health care and environment- potentials in modern biotechnology- achievements in biotechnology.

UNIT IIPLANT TISSUE CULTURE 9

Tissue culture as a source of genetic variability: Introduction-Variation: somaclonal and gametoclonal variation, sources and causes of variation, selection of variants, application in crop improvement- Protoplast: isolation, culture and fusion, selection of hybrid cells, regeneration of hybrid plants-Somatic hybridization and Cybridization- Micropropagation as a tool of in vitro multiplication- production of pathogen free plants through virus elimination- secondary metabolite production through plant cell cultures.

UNIT IIITRANSGENIC TECHNOLOGY IN PLANTS 9

Genetic Transformation methods for production of transgenic plants: Direct Gene Transfer Methods, Agrobacterium mediated genetic transformation (Indirect), Chloroplast transformation, transplantomics. Production of genetically modified plants/crops: transgenic plants for biotic and abiotic stress tolerance, transgenic plants for quality traits, herbicide and pest resistance, Industrial enzymes, Molecular farming for therapeutic protein: Plantibodies, Plantigens and Edible Vaccines.

UNIT IVANIMAL CELL CULTURE 9

Animal cell culture: history- requirements for animal cell and organ culture-culture media: natural and synthetic media-sterilization of glassware, equipment and culture media-maintenance of different cell lines-characteristics of animal growth in culture-Cultivation of animal cells in bioreactor-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-stem cell culture

UNIT VTRANSGENIC TECHNOLOGY IN ANIMALS 9

Basic steps in gene cloning-methods of gene transfer: calcium phosphate co precipitation, electroporation and microinjection-Screening of recombinants: marker inactivation technique. Cloning strategies: genomic and cDNA cloning (basic concepts)-Cloning of insulin gene-Development of transgenic animals and applications-DNA finger printing techniques-Biopharming- xenotransplantation- genetically engineered animals- mapping of human genome- ethical issues in animal biotechnology- Intellectual property rights- patenting.

TEXT BOOKS:

1. Adrian Slater, 2006, "Plant biotechnology", 3rd Ed,.
2. Fr. S. Ignacimuthu, 2000 Plant biotechnology IV ed.
3. R.C.Dubey, 2004, "Text book of Biotechnology" 3rd Ed.

REFERENCE BOOKS:

1. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009," Plant Biotechnology"

2. SudhaGangal , 2002, “Principles and Practice of Animal tissue culture”, IV Ed
3. P. Ramadass , 2008, “ Animal Biotechnology” MJP pub

P18PRBT101	BIO RESEARCH METHODOLOGY AND IPR	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing				
	Crse 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
CO6	To prepare research articles

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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)
					√				

4	Approval	37th Meeting of Academic Council, May 2015

UNIT I INTRODUCTION **9**

Meaning of Research, Objectives of Research, Motivations in Research, types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research

UNIT II DEFINING THE RESEARCH PROBLEM **9**

Concept and need, Identification of Research problem, defining and delimiting Research problem- Variables and their linkages, characteristics of good Hypothesis Research question and formulation of hypotheses-

directional and non-directional hypotheses, Basis for hypotheses

UNIT III RESEARCH DESIGN 9

Meaning, Need, Features of Good Design, Concepts, Types- Basic principles of Experimental Design, various methods of Research-Survey, Philosophical, Historical, Experimental, Causal Comparative, Genetic, Case Studies

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. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.
2. C.R. Kothari, 1997, Research Methodology (Methods and Techniques) New age Publishers

REFERENCE BOOKS

1. P. Ramadass, 2009, Research and writing: Across the disciplines, MJP publishers.

P18PCBT1L1	**BIOCHEMISTRY AND MICROBIOLOGY LAB**	**L**	**T**	**P**	**C**	
	Total Contact Hours: 60	**0**	**0**	**4**	**2**	
	Prerequisite: Introduction to Biotechnology, genetic engineering					
	Course Designed by : Dept of Industrial Biotechnology					
OBJECTIVES: To provide a basic knowledge of biochemical components and its functionsand 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 enzyme metabolism					
CO3	to know the application of biomolecules in functioning of biological system					
CO4	to know the visualization of microbes by different microscopes					
CO5	to understand the source of microbes and their role 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
2	CO1	H	H	H		

	CO2				L	M
	CO3	H	M		H	L
	CO4			M	L	
	CO5	H	M			H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

List of Experiments

1. Qualitative analysis of Unknown sugar-Monosaccharides,disaccharides and polysaccharides.
2. Estimation of sugar- Benedicts method.
3. Qualitative of unknown protein-Albumin,casein and gelatin.
4. Quantitative test for protein – Biuret method.
5. Quantitative test for protein –Lowry method.
6. Quantitative test for protein – Bradford method
7. Isolation of Bacteria Soil
8. Motility of Bacteria
9. Staining techniques
10. Streak Plate techniques
11. Antibiotic sensitivity test
12. Biochemical Analysis

P18PCBT1L2	**PLANT AND ANIMAL BIOTECHNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	**0**	**0**	**4**	**2**
	Prerequisite: Introduction to Biotechnology, genetic engineering				
	Course Designed by : Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic knowledge of plant biotechnology and genetic engineering, its functions and their Applications from the perspective of engineers

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of plant tissue culture
CO2	to apply the basic concept of recombinant DNA

CO3		to know the application of genetic engineering techniques				
CO4		to understand the fundamentals of animal cell cultures				
CO5		To know basic concepts of transformation				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	B	c	d	E
2	CO1	H	H	H		
	CO2				L	M
	CO3	H	M		H	L
	CO4			M	L	
	CO5	H	M			H
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
		√				
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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, purification and determination of viability of protoplast from *Aloe vera*leaf mesophyll cells.
9. Protoplast fusion using PEG.
10. Preparation of synthetic seeds.
11. Isolation of Rhizobium from ground nut nodules and preparation of biofertilizer

SEMESTER II

P18PCBT201	**DOWNSTREAM PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Instrumentation, separation process, chemical engineering				
	Course Designed by : Dept of Industrial Biotechnology				

OBJECTIVES: To provide basic knowledge about various separation techniques in bioprocesses						
COURSE OUTCOMES (COs)						
CO1		to understand the unit operations involved in downstream				
CO2		to know about various separation processes				
CO3		to know the application of centrifugation in product delivery				
CO4		to get a basic knowledge of crystallization				
CO5		to know about the product recovery and purification 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
2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3		M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
		√				
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT IINTRODUCTION 9

Role of downstream processing in biotechnology-Characteristics of biotechnology products, overview of bioprocess including upstream and downstream process, Cost cutting strategies, characteristics of biological mixtures, process design criteria for various classes of byproducts.

UNIT II SEPARATIONTECHNIQUES 9

Physico-chemical basis of bioseparation processes, Cell Disruption; Principle of operation, Types and applications-recent development in product isolations- Removable of insolubles- Filtration & Micro filtration, Centrifugation,

UNIT IIIEXTRACTION METHODS 9

Membrane separations-Enrichment operations: Precipitation methods (with salts, organic solvents and polymers), ATP method, Super critical extractions- Extraction-batch, staged, Differential, Fractional types; Adsorption- Batch, continuous stirred tank, Principles and applications.

UNIT IV CHROMATOGRAPHIC TECHNIQUES 9

Product resolution and fractionation – chromatographic techniques – Chromatofoccusing – electrophoresis of protein and nucleic acids, 1D – 2D gels, types of electrophoretic techniques (capillary and pulse field)

UNIT V CRYSTALLIZATION 9

New and emerging technologies: dialysis, Pervaporation, Polishing techniques – Crystallization, Drying – Various types, principles & applications.

TEXT BOOK:

1. Siva Shankar, 2004, “Bioseparation” III Ed,

REFERENCES BOOKS

1. Raja Ghosh, Principles of Bioseparations Engineering, World Scientific Publications, 2006.
2. P.A. Belter, E.L. Cussler, W.-S. Hu, Bioseparations: Downstream Processing for Biotechnology, John Wiley and Sons, New York (1988).

18PCBT202	**BIOPROCESS ENGINEERING AND PLANT DESIGN**			**L**	**T**	**P**	**C**
	Total Contact Hours: 45			**3**	**0**	**0**	**3**
	Prerequisite: Chemical engineering, principles of Bioprocess engineering						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic knowledge of bioprocesses and its usage in bioreactors and their design							
COURSE OUTCOMES (COs)							
CO1	to understand the development of bioprocess techniques						
CO2	to know about various unit operations involved in bioprocess						
CO3	to know about the instrumentation and control for bioprocess operations						
CO4	to know about design of bioreactors						
CO5	to develop a pilot plant design and their cost						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low							
1	COs/Pos	a	B	c	d	e	
2	CO1	H	H	H	M		
	CO2	H			L	L	
	CO3	H	M	M		M	
	CO4	H		M	L		
	CO5	H	L	H		M	
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√					
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT IBIOPROCESS AND METABOLIC STOICHIOMETRY 9

Introduction to bioprocess – historical development - overview of traditional and modern application of biotechnology industry – unit operations involved in bioprocess – stoichiometry of cell growth and product formation – elemental balances – degree of reduction – maintenance co-efficient.

UNIT II KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION9

Phases of cell growth in batch culture – simple unstructured kinetic models for microbial growth, Monod model – growth of filamentous organisms – growth associated and non-growth associated product formation kinetics – substrate and product inhibition on cell growth and product formation - structured models for

growth and product.

UNIT IIIPROCESS PLANT DESIGN 9

General design information – material and energy balance calculation – equipment design and specifications – marketability of the product – availability of technology, raw materials, equipments, human resources, land utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production cost.

UNIT IV COST ESTIMATION 9

Capital investment – fixed capital investments including land, building, equipments and utilities, installation cost, working capital investment – manufacturing cost – direct production cost (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, etc.), fixed charges (including depreciation, taxes insurance, rental cost etc.)

UNIT V INSTRUMENTATION AND CONTROL 9

Introduction – methods of measuring process variables: T, P, pH measurement analysis, flow measurement, inlet and exit gas analysis – computer based data acquisition – LABVIEW, MATLAB, SIMULINK & ISIM Softwares.

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.

P18PCBT2L1	**BIOPROCESS ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**0**	**0**	**4**	**2**
	Prerequisite: Instrumentation, separation process, chemical engineering				
	Course Designed by : Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic knowledge of bioprocess, its functions and their applications

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of bioprocess techniques
CO2	to understand the fundamentals of separation methods
CO3	to know the physical parameters
CO4	to get a basic knowledge of fermentation
CO5	to know basic concepts of product 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
2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3	H	M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

List of Experiments

1. Estimation of biomass production.
2. Plate assay
3. Media optimization by Plackett-Burmann method.
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. Enzyme kinetics.
9. Estimation of k_La by sulphite oxidation method.
10. Thermal death kinetics of yeast.
11. Solid state fermentation.
12. Production of wine
13. Production of soap and analyze its properties.
14. Production of biodiesel and analyze its properties.
15. Isoelectric precipitation
16. Settling characteristics
17. Flocculation (Jar Test)

P18PCBT2L2	**DOWNSTREAM PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**0**	**0**	**4**	**2**
	Prerequisite: Instrumentation, separation process, chemical engineering				
	Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of bioprocess, its functions and their applications					
COURSE OUTCOMES (COs)					
CO1	to understand the techniques				
CO2	to understand the fundamentals of separation methods				

CO3		to know the purification techniques				
CO4		to get a basic knowledge of product formulation				
CO5		to know basic concepts of product 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
2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3	H	M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
		√				
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

List of Experiments

1. Enzyme Purification by Salt precipitation Method
1. Saltling characteristics
2. Flocculation (Jar Test)
3. Solids Recovery by Centrifugation
4. Paper chromatography
5. Thin Layer Chromatography
6. Ion –Exchange Chromatography
7. Affinity Chromatography
8. Gel Filtration
9. Sonication
10. Crystallization
11. Aqueous Two Phase Extraction Of Proteins

P18PRBT2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours -60	**0**	**0**	**4**	**2**
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology				
	Course Designed by– Dept. of Industrial Biotechnology				
OBJECTIVES To enable students to do independent research					

COURSE OUTCOMES (COs)					
• It is a two credit course offered in the III Semester • Each student will be allocated a guide and a research topic at the end of the II semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students • Two days are allocated per week for the students to do research. This will be considered for the award of internal marks. • There will be three reviews to assess the progress of their research • The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. The student also should publish a paper in a journal or in a conference proceeding					
1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√
2	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

SEMESTER III

P18PRBT3P1	DISSERTATION-PHASE I	L	T	P	C
	Total Contact Hours -60	**0**	**0**	**20**	**10**
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology				
	Course Designed by– Dept. of Industrial Biotechnology				

OBJECTIVES

To enable students to do independent research

COURSE OUTCOMES (COs)

- It is a six credit course offered in the III Semester
- Each student will be allocated a guide and a research topic at the end of the II semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students
- Two days are allocated per week for the students to do research. This will be considered for the award of internal marks.
- There will be three reviews to assess the progress of their research
- The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. The student also should publish a paper in a journal or in a conference proceeding

1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√
2	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

SEMESTER IV

P18PRBT4P1	**DISSERTATION-PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours -35 hrs per week	0	0	32	16
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology, Downstream process				
	Course Designed by– Dept. of Industrial Biotechnology				

OBJECTIVES: To enable students to do independent research

COURSE OUTCOMES (COs)

- It is a 12 credit course offered in the IV Semester
- The Project phase I guide continues to guide the students in Project Phase II also.
- There is no course work during this semester and the student is free to do the project.
- There will be three reviews to assess the progress of their research
- The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic.

1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√
2	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

ELECTIVES

P18PEBT011	**INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY**	**L**	**T**	**P**	**C**

	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: General microbiology				
	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 microscope
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
2	CO1	H	H	H		
	CO2	M		H	L	M
	CO3	H	M		H	L
	CO4	H		M	L	
	CO5	H	M			H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

History and scope of Microbiology, Identification of Microorganisms, Prokaryotes and Eukaryotes, Bacterial Taxonomy, Microscopy, Bright Field, Phase contrast, Fluorescence and Electron Microscope, Specimen Preparation for Microscopy, General Structural organization of Bacteria and other microorganisms, Arachae bacteria.

UNIT II CULTURE MEDIA 9

Microbial nutrition, Growth of Microorganisms in different Media, Isolation of Pure culture, Growth curve of Microbes, Culture of Microorganisms-continuous and synchronous culture, Enumeration of Microorganisms, Preservation of Microbial Culture, Mode of Nutrition Transport in Microbes, Effect of pH, temperature, osmotic Pressure on Growth of Microbes, antimicrobial agents and disinfectants.

UNIT III FERMENTATION PROCESS 9

Historical view of Fermentation Process and products, Outline of various unit operation involved in integrated bioprocesses, Isolation, Preservation and improvement of Industrial Microorganisms, Medium Requirement for Fermentation processes, Carbon, Nitrogen, Minerals, Vitamins and Other Nutrients.

UNIT IV PRIMARYMETABOLITES 9

Production of primary metabolites, organic acids (citric acid, itaconic acid, acetic acid, gluconic acid), Amino

acids (glutamic acid, lysine, aspartic acid, phenylalanine), alcohols (Ethanol, 2,3-butanediol). Production of secondary metabolies-antibiotics-betalactams (penicillin- cephalosporin)- Aminoglycosides (streptomycin, kanamycin)-Macrolides (erythromycin)- Vitamins, Production of Vaccines and Recombinant Proteins-Proteases, Amylases, Lipases.

UNIT VI NDUSTRIALAPPLICATIONS **9**

Microorganisms in waste water treatment, Bio-fertilizers and Bio-Pesticides, Recycling of biomaterials, production of biogas, plant growth factors. Natural Bio preservatives (nisin), Bio-Polymers (Xanthan gum and PHB), Single Cell Protein

TEXT BOOKS:

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg, 2005, "Microbiology "TATA McGraw Hill, 5th Ed.

REFERENCE BOOKS:

1. Anantha Narayan, C.K. JayaramPaniker, 2009, "Text Book of Microbiology" Orient Blackswan, 7th Ed.
2. Presscott and Dunn, 2006, "Industrial Microbiology" CBS Publishers& Distributors.

P18PEBT012	**ENZYME ENGINEERING**			**L**	**T**	**P**	**C**
	Total Contact Hours: 45			**3**	**0**	**0**	**3**
	Prerequisite: Introduction to Biotechnology, Biochemistry						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a knowledge about enzymes and its kinetics							
COURSE OUTCOMES (COs)							
CO1	to understand the applications of enzymes in various fields						
CO2	to know about kinetics of enzyme						
CO3	to know about the applications of enzymes						
CO4	to know about immobilization and its applications						
CO5	to get ideas about various bioreactors and its uses						

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

1	COs/Pos	a	b	c	d	e
2	CO1	H	H	H		
	CO2	H		H	L	M
	CO3	H	M		H	L
	CO4			M	L	
	CO5	H	M			H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT IINTRODUCTION 9

Introduction to Enzyme Technology, Definition of Biochemical process, Application to pharmaceutical, medical, fine chemicals and herbal, food Industries, comparison of chemical and biochemical process, scope of chemical Engineering operations, Microbial strain cultivation, synthesis of typical biologicals.

UNIT II ENZYME KINETICS 9

Introduction to Enzyme Kinetics, Nature and Function of Enzymes, Coenzymes and cofactors Classification of Enzyme, Practical application of Enzyme in bioprocess of Industrial importance, Mechanism of Enzymatic Reaction-MichaelisMenten Equations for Non inhibiting and inhibiting reaction substrate, product inhibition classification of inhibition and their Mechanisms.

UNIT III MICROBIAL ENZYME KINETICS 9

Fundamentals of Microbial Kinetics, Growth curve of microbial cells, Factors affecting growth, Monod Model, Modelling of Continuous and Batch growth, immobilization of cells and Mechanisms with rate equations.

UNIT IVTRANSPORT PHENOMENA9

Microbial Transport, Introduction to factors influencing transport phenomena, Newtonian and Non Newtonian behaviour of broth. Agitation and Mixing, Power consumption, Gas/Liquid transportation in cells, mass transfer coefficients and their role in scale up of Equipments, Enhancement of Oxygen transfer, Heat transport in Microbial systems, Sterilization cycle and Examples of Heat addition and removal in process

UNIT VBIOREACTORS 9

Bioreactors: Classification, Batch and continuous types, High performance bioreactors, Sterile and Non sterile operations, Reactors in series, Recycle Reactors. Applications of Enzyme technologies in Effluent treatment, downstream operation with reference to membrane separations and fermentation methods in waste treatment, waste treatment and disposal.

TEXT BOOKS:

1. Manjula, 2006, "Bio and Enzyme Engineering", III Ed.

REFERENCE BOOK:

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,

P18PEBT013	**ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	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

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
CO6	to know about IPR

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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	
	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	37th Meeting of Academic Council, May 2015							

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 Heavy metals-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

TEXT BOOK

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".
3. Weblink: nptel

P18PEBT021		**PRINCIPLES OF PROCESS ENGINEERING**			**L**	**T**	**P**	**C**
		Total Contact Hours: 45			**3**	**0**	**0**	**3**
		Prerequisite: chemical engineering, bioprocess engineering, thermodynamics, heat and mass transfer						
		Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic knowledge of Process engineering								
COURSE OUTCOMES (COs)								
CO1		to understand the various unit operations involved in industry						
CO2		to know the material and energy balance for a process						
CO3		to get an idea about fluid mechanics						
CO4		to know about agitation and the types of agitators						
CO5		to know about mass transfer and drying 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		
2	CO1	H	H	H				
	CO2	L		H		M		
	CO3		M		H			
	CO4	H		M	L			
	CO5		M			H		
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
		√						
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNITI OVERVIEW OF PROCESS INDUSTRY **9**

Unit operations & Process - Conservation of mass & Energy -Stoichiometry- SI units & Conversion

Material Balances: Overall and component material balances - Conversion -Yield - Selectivity - Material balances without chemical reactions and with chemical reactions

UNIT IIENERGY BALANCES **9**

Energy- Forms of energy- Energy balances - Entropy - Latent heat -Hess's law- Standard heat of Reactions.Fluid Mechanics-Fluids-Types- Nature of flow-Bernoulli's Equation – Manometers - Pressure losses in flow systems.

UNITIIIAGITATION AND TRANSPORTATION OF FLUIDS 9

Mixing and Agitation – Flow patterns- prevention of swirling- types of impellers- Power consumption - Pumps –Reciprocating: Single acting and double acting pump Centrifugal pump- Work of consumption.

UNIT IVHEAT 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- Derivation of Over all heat transfer coefficient - LMTD. Evaporator- Types: falling film-Climbing film-Forced circulation and Agitated film evaporator-Methods of feeding.

UNIT VMASS TRANSFER 9

Diffusion: Outline of Mass transfer operations-Diffusion in Gases, Liquids and Solids. Distillation: Theory of Simple, Flash, Steam and Azeotropic distillation-McCabeThiele method. Drying: Drying equipment: Tray, Screen-conveyor, Rotary and Spray dryer-Selection of drying equipment- Time of drying.

TEXT BOOK:

1. K.A.Gavhane,2009,"Introduction to process calculations stoichiometry" NiraliPrakasham Publications 25th Ed.

REFERENCE BOOKS:

1. K.A. Gavhane, 2009, "Fundamentals of chemical engineering" NiraliPrakasham Publications 25th Ed.,
2. McCabe and Smith,2002, "Unit operations in Chemical Enginering", Tata McHraw Hill Pblications, 6th Ed.
3. Bhat & Vora,2001, 'Stoichiometry", Tata McGraw Hill Ltd, III Ed

P18PEBT022	DIARY TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Food Process engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To explore the different techniques involved in diary science

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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	

	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT IINTRODUCTION **9**

Market milk – market milk industry in India – Collection, Transportation of milk- milk reception – Clarification- Chilling – Homogenisation – Sterilization- Pasteurization – UHT processing of fluid milk – aseptic packaging – Special milk – Clean Milk Production – Grading of Milk.

UNIT IIDAIRY 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. Concetrated 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, mozerella 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 VQUALITY CONTROL & 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

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" .

REFERENCES

1. Andrews,2004, "Biochemistry of Milk Products" Black rabbit books, 2nded.
2. Ananthakrishnan C P., and Padmanabhan " The technology of milk processing" Shrilakshmi publications

P18PE2BT023	CANCER BIOLOGY	L	T	P	C

	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Medical Biotechnology, Animal Biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of cancer and its implications

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of cancer cells and its constituents
CO2	to know the concept of carcinogenesis and carcinogenic agents
CO3	to find the environmental factors related to cancer
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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√		
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

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-metastasis, 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 IIIONCOGENES 9

Molecular Cell Biology of Cancer- Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Growth factors and growth factor receptors as oncogenes.

UNIT IV CANCER TYPES 9

Different sites and forms of cancer, Lung, Liver, Breast, Cervical, Blood, Prostrate, Ovarian cancers – epidemiology, 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

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

P18PEBT031	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Introduction to Biotechnology				
	Course Designed by : Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of recombinant DNA Technology

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 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
2	CO1	H	H	H		
	CO2	H	L		L	M
	CO3	H	M	M	H	L
	CO4	H		M	L	
	CO5	H	L	H		H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I DNA MODIFYING ENZYMES 9

RDNA technology: Introduction, Basic systems: enzymes in genetic engineering: restriction endonucleases: Types and characteristic features, Nomenclature, Modification of cut ends: linkers, adapters and homopolymers-DNA ligases- methylase-alkaline phosphatase-topisomerase-Polynucleotide kinase-Exonuclease III-DNase I-DNA polymerase and Klenow fragment- Terminal nucleotidyl transferase- RNA dependent DNA polymerase

UNIT IIVECTORS/CLONING VEHICLES 9

Introduction: features of an ideal vector- types of vectors: cloning and expression vectors- Plasmids: pBR322, pUC18, phage vectors-cosmid vectors-phagemids-YAC vectors-BAC vectors-Shuttle vectors-Yeast vectors-Ti plasmid vector-Plant viral vectors (CaMV)-Animal viral vectors- SV 40 (3 types)- Expression vectors in Prokaryotes and Eukaryotes

UNIT III RDNA TECHNIQUES 9

Genomic DNA libraries-transformation methods-transfection-selection and screening of recombinants-direct and indirect selection methods, blue-white selection-GUS expression-colony hybridization-in vitro translation-blotting techniques: Southern, Northern and Western blotting-PCR-DNA labeling techniques-RFLP and RAPD-DNA sequencing-genome mapping: physical and genetic mapping, chromosome walking and chromosome jumping.

UNIT IVAPPLICATIONS OF RDNA TECHNOLOGY IN ANIMALS 9

Animal cloning-Transgenic animals-production of insulin, interferon, vaccines, growth hormones and other pharmaceutical production-IVF-embryo transfer-nuclear transplantation-embryonic stem cells-knockout mice-animal bioreactor and molecular pharming- Gene therapy types; somatic cell and germline gene therapy, applications, problems and prospects

UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN PLANTS 9

Transgenic plants with reference to disease and pest resistances, herbicide tolerance, biotic and abiotic stress tolerance-transgenic plants for crop improvement-cytoplasmic male sterility-delay in fruit ripening-Bio-pharmaceuticals and secondary metabolite production

TEXT BOOK:

1. Brown TA,2000, “Gene cloning-and introduction” VNR (U.K) Co Ltd.
2. R.C. Dubey, A Textbook of Biotechnology, S. Chand publishers, 2013

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.

P18PEBT032	**NANOBIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Introduction to Biotechnology				
	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 nanoparticles					
CO2	to understand the various nanodevices					
CO3	to know about nanomolecules					
CO4	to know about various techniques for nanoparticle analysis					
CO5	to know about applications of nanomolecules in various fields					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION **9**

Definition- bottom up and top down approaches-micro and nano machining-micromachinednanodevices-microprobe arrays-multiple nanoprobes- microfluidic devices.

UNIT II MANIPULATION OF DNA **9**

Stretch and positioning of DNA- molecular surgery of DNA-microfabricated probes- manipulation of giant DNA molecules- globular transition- laser trapping of single DNA- globule coil transformation- mapping and cutting of stretched DNA- recovery of DNA fragments- microreactors for DNA manipulation

UNIT III NEAR FIELD OPTICS **9**

Diffraction barrier- SNOAM probe design, configuration, imaging-applications- vibrational spectroscopy-scanning near field optical microscopy.

UNIT IV ATOMIC FORCE MICROSCOPY **9**

Principles- applications- nanotribology- scanning force microscopy- control and fabrication of nanometric oscillators- nanometric parallel leaf springs, cantilevers- nano oscillators- scanning tunneling microscopes: operating principles, structure, surface and bulk micromachining- micro STM fabrication technology-characterization and application of fabricated micro STM.

UNIT V NANOSCALE CHARACTERIZATION **9**

Semiconductor nanostructures- STM and spectroscopy for semiconductors- scanning tunneling spectroscopy-ballistic electron emission microscopy- STM/STS and laser illumination- scanning capacitance microscopy-electrostatic force detection- Kelvin probe force microscopy.

TEXT BOOK:

1. K.K. Jain , 2006, "Nanotechnology in molecular diaprostics – current techniques & applications"

REFERENCE BOOKS:

1. Microbial bionanotechnology edited by Bernard H.A. Relim

Applications of nanoparticles in biology & medicine O.V. Salate. Journal of nanobiotechnology (2004), 2:3

P18PEBT033	**IMMUNOTECHNOLOGY**	**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
2	CO1	H	H	H		
	CO2	M	L		L	M
	CO3	H	M	M	H	L
	CO4	H		M	L	
	CO5	H	L	H		H

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

Introduction-cells and organs of the immune system, origin of immune system, types of immune system, - Antigenes – antigenecity, antigenic determinants, haptens and epitopes, Antibodies-Structure, Classification, allotypes and idiotypes.

UNIT II THE IMMUNE RESPONSE 9

Immune Response – primary and secondary-humoral and cell mediated immunity, antibacterial and antiviral immunity, Mechanism of antigen recognition by T and B-lymphocytes, Functions and synthesis of lymphokines, importance of antigen presentation and MHC class II molecules in T – cell cloning.

UNIT IIIANTIGEN-ANTIBODY INTERACTIONS 9

Immune techniques- antigen–antibody reactions, cross reactivity, precipitation I actions, agglutination reactions, RIA, ELISA, Immuno-precipitation, Immuno-flourescence, synthetic vaccines and recombinant vaccines.

UNIT IV COMPLEMENT SYSTEMS 9

Complement Systems – components, nomenclature, activation of complement, complement receptors and alternate pathway, complement fixation test, immunization practices – vaccines, toxoids, killed and attenuated vaccines, Active and passive immunization, monoclonal antibodies production, purification and characterization, application of monoclonal antibodies in biomedical research

UNIT VHYPERSENTIVITY 9

Hypersensitivity reactions, autoimmunity-organ specific and systemic autoimmune diseases, pathogenesis, diagnostic aspects and treatment, Tumor immunology- Tumor antigens, immune response to tumors, Approaches to cancer immunotherapy-immunodiagnosis

TEXT BOOKS:

1. Janis Kuby,2007, “Immunology” W.H. Freeman & Co. 6th ed.
2. Roitt I, 2001, "Essential Immunology". Blackwell Scientific Publications, Oxford.

REFERENCES BOOKS

1. Tizard, 1992, “Introduction to Immunology” Saunders collage publication, 3rded.
2. Abbas,2009, “Basic Immunology” W.B. Saunders company, 2nded.

P18PEBT041	**STEM CELL AND TISSUE ENGINEERING**			**L**	**T**	**P**	**C**
	Total Contact Hours: 45			**3**	**0**	**0**	**3**
	Prerequisite: Animal Biotechnology						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic understanding of stem cells and their applications							
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	
2	CO1	H	H	H	M		
	CO2	H	H		L	L	
	CO3		M			M	

	CO4	H		M		H			
	CO5	H	L	H		H		M	
3	Category	Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	
		√							
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION **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, and Stem cell marker.

UNIT II HUMAN EMBRYONIC STEM CELL **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 hESC cell lines, Developments regarding establishment of human stem cell banks and registries

UNIT III NEUROCULTURE **9**

Stem cell biology-Preparation of complete human neuroculture, Culturing and subculturing human neurospheres, Differentiation of cells from human, neurospheres into neurons, astrocytes and oligodendrocytes, Immunolabelling procedures human embryonal stem cell and germ cell culture.

UNIT IV ANTENATAL DIAGNOSIS **9**

Antenatal diagnosis- types of gene therapy-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 foetal 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 CULTURE OF CELLS **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

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 publishers

P18PEBT042	FOOD PROCESS ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3

		Prerequisite: Instrumentation, separation process, chemical engineering				
		Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic technologies involved in food processing						
COURSE OUTCOMES (COs)						
CO1		to understand basic concepts in sterilization of food products				
CO2		to know about various dryers				
CO3		to know about the mixing equipments for various products				
CO4		to know about various preservation techniques for food products				
CO5		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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√			
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION **9**

Food processing industries in India: status, scope- categorization of food processing industries- food preservation–National food processing policy of India – tenth plan initiatives

UNIT IIFOOD SPOILAGE, PREVENTION, FOOD SAFETY **9**

Food spoilage causes – biological changes – factors effecting bacterial growth – yeasts – mold – food borne diseases – control of microorganism- prevention of microorganisms sterilization techniques – Thermal death time – food additives: uses, types – HACCP- definition, principle, guidelines.

UNIT III POST HARVEST PROCESSING **9**

Perishable foods of fruits & vegetables metabolic inhibitors- preservation – time/temp-tolerance hypothesis-Hicks theory- Ethylene biosynthesis-controlled atmosphere technique- factors effecting food storage-fruit ripening – CA generators-post harvest disease-respiratory gases- preservation of nuts of dried fruits

UNIT IVFOOD PROCESSING TECHNOLOGIES **9**

Drying of food-goals-guidelines-pretreatment of fruits of vegetables-drying methods: oven drying, food dryer-sun drying-other drying method-water activity-intermediate moisture food concept-hurdle technology-recommended additives to reduce pH, inhibition microbes to prevent burrowing-thermal treatment-freeze drying-freezing of food-food irradiation food sterilization-Extrusion technology.

UNIT VGRAIN STORAGE **9**

Storage types-disinfestation of grains-controlled atmosphere storage-useful of CO_2 in one shot system-control

of yeast and mold- seed viability-multiplication of lactic acid bacteria-storage of wet grains-feed back inhibition-grain storage in developing countries.

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, 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.

P18PEBT043	**BIOPHARMACEUTICAL TECHNOLOGY**			**L**	**T**	**P**	**C**
	Total Contact Hours: 45			**3**	**0**	**0**	**3**
	Prerequisite: Instrumentation, separation process, chemical engineering						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic understanding of pharmaceutics and their applications							
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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√		
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

Introduction to biopharmaceutics – bioavailability – factors influencing bioavailability: factors influencing drug absorption from the gastrointestinal tract.

UNIT II DRUG FORMULATION 9

Manufacturing Principles – Compressed tablets – wet granulation – Dry granulation or slugging –Direct compression – Table presses formulation – Coating – Pills – Capsules sustained action dosage forms – Parental solutions – Oral liquids – injections – ointments – standard of hygiene and good manufacturing practice.

UNIT III DRUG BINDING 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 organs and enzymes – phase I reactions – phase II reactions – first pass effect –factors affecting biotransformation of drugs – bioactivation and tissue toxicity.

UNIT V PRODRUG 9

Bioprecursorprodrugs – carrier prodrugs – application of prodrug design: enhancement of drug stability and dissolution rate – enhancement of bioavailability – site specific drug delivery – Imitations of prodrug design.

TEXT BOOK

1. D.M. Brahmankar Sunil B.Jaiswal, 2008, "Biopharmaceutics and Pharmacokinetics" VallabhPrakashan, 1st Ed.

REFERENCE BOOKS:

1. Remington's Pharmaceutical Sciences, Mack Publishing and Co.,
2. Vyas SP,2007, "Pharmaceutical biotechnology" CBS Publishers & Distributors.
3. Grovess MJ,2006, "Pharmaceutical biotechnology" CRC Press, 2nd Ed.

2.

P18PEBT051	**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				

OBJECTIES

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 BIO INFORMATICS 9

Introduction to bioinformatics – Databases, Classification – Biological Databases, and application – Data mining and Applications – Sequence Database search – FASTA – BLAST.

UNIT II GENOMICS 9

Genome – Organization of Eukaryotic genome – Mitochondrion and chloroplast 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 – Phylogenetic analysis – 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

Protein extraction – Separation and digestion techniques – Mass spectrometry –MALDITOF – Peptide mass finger printing – Peptide sequence analysis – SALSA and TMS

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.
3. Weblink: nptel

P18PEBT052	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

COURSE OUTCOMES (COs)

CO1	To understand the fundamentals transport phenomena
CO2	To know about various types of reactors
CO3	To know about instrumentation and control of reactors
CO4	To learn the process of modulation and simulation of fermentation process
CO5	To understand plant and animal cell reactors
CO6	To get the knowledge of bioreactors and its Industrial

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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		M	L	L	
	CO2	H	M	M	H	H		M	H				M
	CO3	H	M			H					L	L	
	CO4	H	M		H	H		M	H		L		M
	CO5	H	M	M	H	H		M		H	L	L	M
	CO6	H			H	H	L	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	37th Meeting of Academic Council, May 2015							

UNIT I BIOREACTOR DESIGN **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 II TRANSPORT PHENOMENA & GROWTH MODELS **9**

Rheology; Gas-Liquid Mass Transfer- Measurement of transfer coefficients; Design of bubble columns; Three-phase flow, mixing, oxygen transfer: isobaric method, non-isobaric model, oxygen transfer in a three-phase flow-Phases of batch growth cycle; Monod Model; Models of Product Formation and Inhibition; Introduction to structured models

UNIT III BIOREACTOR INSTRUMENTATION AND CONTROL **9**

Introduction, bioreactor sensor characteristics, temperature measurement and control, principles of dissolved oxygen measurement and control, principles of pH/redox measurement and control, detection and prevention of foam, determination of biomass, ion specific electrodes, biosensors.

UNIT IV FERMENTATION CONTROL 9

Introduction to control: control loop, analogue and digital control, control algorithm-PID control, time-proportional control. Physical control of fermentation

MODELING AND SIMULATION OF FERMENTATION PROCESSES

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. 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.

REFERENCE BOOKS

1. Stanbury PF,1984, "Principles of fermentation technology" SS Hall, 2nd.
2. Mansi El Mansi.2003 "Fermentation Microbiology & Biotechnology".IVEd.
3. Weblink: nptel

P18PEBT053	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Basic biotechnology, Bioprocess Engineering, Environmental science				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic knowledge about Safety engineering

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 know about safetyguards and application
CO5	to understand various personal protective equipments and first aid

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

1	COs/Pos	a	B	c	d	e
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√		
4	Approval	37th, 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

Safety in Process Plants – Hazard Analysis – Types of Hazard – hazard Identification techniques Hazard Evaluation – Important Factories Act.

UNIT II TYPES OF HAZARDS 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 IIISAFETY MANAGEMENT & 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 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 equipments- Respiratory type-First 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.

TEXT BOOK

1. Nicholas, 2008, "Practical Guidance to Industrial Safety" 3rded.
2. Prof.M.H.Fulekar, 2007, "Industrial Hygiene & chemical Safety" 2nded.

REFERENCE BOOKS:

1. Rudd,2005, "Strategy of process engineering" Willey
2. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

OPEN ELECTIVE

	BUSINESS ANALYTICS	L	T	P	C
P18OECS001	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

- **OBJECTIVES**
  1. Understand the role of business analytics within an organization.
  2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
  3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
  4. To become familiar with processes needed to develop, report, and analyze business data.
  5. Use decision-making tools/Operations research techniques.
  6. Mange business process using analytical and management tools.
  7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- To apply the dynamic programming to solve problems of discreet and continuous variables.
- To apply the concept of non-linear programming.
- An ability to carry out the sensitivity analysis.
- An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical AnalysisandSimulation of Game Theory **9 Hours**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEME003	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	0	0
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

- **OBJECTIVES**
- 1. To study about the industrial safety and types.
- 2. To know about the tools and fundamentals of maintenance.
- 3. To study about the methods of wear and corrosion and their prevention
- 4. To know about the importance of fault tracing and its concepts.
- 5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

Total No. of Periods: 45

References Books:

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.

P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management 10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance

budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

P18OECE007	**ENVIRONMENTAL HEALTH ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Waste Management				
	Course Designed by – Dept of Civil Engineering				

Module I INTRODUCTION **9 Hours**

Impact of Development and Water Pollution – Ecology and ecosystems Impact of development, land use and natural resource management, Cause and effects of environmental pollution

Module II SOURCES OF POLLTION **9Hours** Natural Processes: Pollution due to industrial, agriculture and municipal wastes – Limitation of disposal of dilution. BOD considerations in streams- Water Pollution control legislation.

Module III AIR POLLUTION **9 Hours**

Air and Noise Pollution and Control- Pollutants and their sources- Effect of pollution of human wealth, vegetation- Air pollution control legislation -noise pollution- sources and effects – Control measures.

Module IV SOLID WASTE MANAGEMENT **9 Hours**

Solid Wastes Management and Water Control Sources - Characteristics Quantities – Collection methods and disposal techniques - Sanitary -landfill -Incineration and pyrolysis – composting - water borne diseases – of mosquitoes, flies, rodents.Rational control and naturalistic methods of control, uses and limitations of pesticides, engineering measures of water control.

Module V FOOD SANITATION **9 Hours**

Food & Milk Sanitation : Relation of food to disease – principles of food sanitation – Sanitation of Kitchen in restaurants and other catering establishments – Quality changes in milk – Milk as carrier of infection – Pasteurization of milk – HTST and LTLT processes. Cattle shed sanitation.

TEXT BOOKS

1. Ehlws V.M. and E.W. Steel. Municipal and Rural Sanitation – McGraw Hill Co. Inc, New York, 1954

REFERENCES

1. Park J.E. and Park K.,"Text Book of Preventing and Social Medicine",M/s. Banarsidos, Bhanot, Jabalpur, 1980.
2. Stern A.C. *ed,* "Air Pollution Vol. I, II & III", Academic Press, New York, 1968
3. CuniffP.E,"Environmental Noise Pollution", John Wiley & Sons, New York. 1977.

P18OEBT008	**BIO ENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Bioprocess, genetic engineering, TQM				

	Course Designed by – Dept of Industrial Biotechnology

Module I ENTREPRENEURSHIP FUNDAMENALS 9 Hours

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

Module II DECISION MAKING AND TIME MANAGEMENT 9 Hours

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

Module III ENTREPRENEURSHIP – FINANCE AND ECONOMIC FEASIBILITY 9 Hours

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

Module IV COMPANY LAWS AND REGULATIONS 9 Hours

Forming companies– Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

Module V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9 Hours

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

REFERENCES

1. Entrepreneurship fundamentals by ZobiasKollmann International journal of Zechnology management,2007

P18OEBM009	**REHABILITATION ENGINEERING.**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Biomedical Engineering				

Module I REHABILITATION TECHNOLOGY 9 Hours

Selection, design or manufacturing of augmentive or assistive devices appropriate for individual with disability

Module II REHABILITATION SCIENCE9 Hours

Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

Module III REHABILITATION ADVOCACY9 Hours

Legal aspect helps the handicapped people in choosing the device, the provisions available to them in this regard.

Module IV REHABILITATION MEDICINE9 Hours

Physiological aspects of functional recovery, neurological and psychological aspects, rehabilitation therapies, training to restore vision auditory and speech

Module V RÉHABILITATION ENGINEERING TECHNOLOGIES: PRINCIPLESOF APPLICATION 9 Hours

Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

Total No. of Periods: 45

REFERENCES

1. Reswick.J. What is Rehabilitation Engineering? ,Annual Review of rehabilitation Volume 2 Springer - Vorlage, New York, 1982.
2. Robinson.C.J, Rehabilitation Engineering, Handbook of electrical engineering, CRC Press, Bocaraton, 1993.

P18OEBM010	**BIO MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Biomedical Engineering				

Module I INTRODUCTION 9 Hours

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, mechanical properties of soft biological tissues.

Module II MECHANICS OF CIRCULATION 9 Hours

Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

Module III MECHANICS APPLIED TO ORTHOPAEDICS 9 Hours

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, analysis of force in orthopedic implants.

Module IV MECHANISM OF BIOLOGICAL SYSTEMS 9 Hours Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

Module V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION 9 Hours

Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

Total No. of Periods: 45

REFERENCES

1. Y.C.Fung, Biomechanics : Mechanical properties in living tissues, Springer Verlag, Newyork1981.
2. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
3. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.

Susan J.Hall , Basics Bio Mechanics 4th Edition, McGrawHill Publishing Co,2002.

AUDIT COURSES I & II

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS:

UNIT I: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

UNIT III: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT IV: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

UNIT V: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	DISASTER MANAGEMENT	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I: **4 Hours**

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II: **4 Hours**

Repercussions Of Disasters And Hazards: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: **4 Hours**

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV: **4 Hours**

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **4 Hours**

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI: **4 Hours**

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In

Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III: **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-BhartiPublication,New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				

	Course Designed by – AICTE

Course Objectives: Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS:

UNIT I: **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism .Moral and non- moral valuation. Standards and principles. Value judgements

UNIT II: **6 Hours**

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, Cleanliness Honesty, Humanity.Power of faith, National Unity.Patriotism. Love for nature, Discipline.

UNIT III: **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude.Positive Thinking.Integrity and discipline.Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

UNIT IV: **6 Hours**

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality ,Non violence ,Humility, Role of Women. All religions and same message. Mind your Mind ,Self-control. Honesty, Studying effectively.

Suggested reading

- Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS:

UNIT I: History of Making of the Indian Constitution **4 Hours**

HistoryDrafting Committee, (Composition& Working)

UNIT II: Philosophy of the Indian Constitution **4 Hours**

Preamble, Salient Features

UNIT III: Contours of Constitutional Rights & Duties **4 Hours**

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: Organs of Governance **4 Hours**

Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of MinistersJudiciary, Appointment and Transfer of Judges, Qualifications,Powers and Functions

UNIT V: Local Administration **4 Hours**

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: Election Commission **4 Hours**

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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0

	Prerequisite – NIL
	Course Designed by – AICTE

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I: 4 Hours

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and Searching.

UNIT II: 2 Hours

Thematic overview:Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

UNIT III: 4 Hours

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: 4 Hours

Professional development:: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V: 2 Hours

Research gaps and future directions: Researchdesign,Contexts,Pedagogy
Teacher education**,**Curriculum and assessment,Dissemination and research impact.

Suggested reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

P18ACYO007	**STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS:

UNIT I: 8 Hours

Definitions of Eight parts of yog. (Ashtanga)

UNIT II: **8 Hours**

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayama

Suggested reading

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

P18ACBA008	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS:

UNIT I: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

UNIT II:

Approach to day to day work and duties.**8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35

Chapter 18-Verses 45, 46, 48.

UNIT III: **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested Reading

- "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
- Department), Kolkata
- Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity

  Study of Neetishatakam will help in developing versatile personality of students

M.Tech – BIOMEDICAL ENGINEERING

(FULL TIME)

I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCBM101	PC	Anatomy and Physiology	3	3	0	0	3
2	P18PCBM102	PC	Advance In Biomedical Instrumentation	3	3	0	0	3
3		PE	Professional Elective I	3	3	0	0	3
4		PE	Professional Elective II	3	3	0	0	3
5	P18PRBM101	PR	Bio-Research Methodology and IPR	2	2	0	0	2
6		AC	Audit Course I	2	2	0	0	0
PRACTICAL								
7	P18PCBM1L1	PC	Bio medical Instrumentation lab	4	0	0	4	2
8	P18PCBM1L2	PC	Anatomy And Physiology Lab	4	0	0	4	2
Total				**24**	**16**	**0**	**8**	**18**

SEMESTER II								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCBM201	PC	Medical Image Analysis	3	3	0	0	3
2	P18PCBM202	PC	Biomedical Signal Analysis	3	3	0	0	3
3		PE	Professional Elective III	3	3	0	0	3
4		PE	Professional Elective IV	3	3	0	0	3
5		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCBM2L1	PC	Medical Image analysis lab	4	0	0	4	2
7	P18PCBM2L2	PC	Biomedical signal Analysis	4	0	0	4	2
8	P18PRBM2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	**26**	**14**	**0**	**12**	**18**

SEMESTER III								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - V	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRBM3P2	PR	Dissertation- Phase – I	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

SEMESTER IV								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
1	P18PRBM4P3	PR	Dissertation- Phase-II	32	0	0	32	16
			Total	**32**	**0**	**0**	**32**	**16**

TOTAL CREDITS FOR THE PROGRAM = 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE

S.No.		SUBJECT NAME	L	T	P	C
PROFESSIONAL ELECTIVE (PE) - I						
1	P18PEBM011	Advanced Biosensor And Transducers	3	0	0	3
2	P18PEBM012	Advance Mathematics For Biomedical Engineering	3	0	0	3
3	P18PEBM013	Computer Based Medical Instrumentation.	3	0	0	3
PROFESSIONAL ELECTIVE (PE) –II						
1	P18PEBM021	Tissue Engineering	3	0	0	3
2	P18PEBM022	Biomaterials And Implantable Devices	3	0	0	3
3	P18PEBM023	Physiological Modeling	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - III						
1	P18PEBM031	Bio MEMS	3	0	0	3
2	P18PEBM032	Health Hospital And Equipment Management	3	0	0	3
3	P18PEBM033	Tele Health Technology	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - IV						
1	P18PEBM041	Advanced Neural Computing.	3	0	0	3
2	P18PEBM042	Nuclear Medicine	3	0	0	3
3	P18PEBM043	Brain Control Interfaces.	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – V						
1	P18PEBM051	Principles Of Genetic Analysis	3	0	0	3
2	P18PEBM052	Human Assist Devices	3	0	0	3
3	P18PEBM053	Advances In Electronics Applied To Hospital Engineering	3	0	0	3

OPEN ELECTIVE

S.No	Code No.	Course Title	L	T	P	C
1	P18OECS001	Business Analytics	3	0	0	3
2	P18OEMA002	Operations Research	3	0	0	3
3	P18OEME003	Industrial Safety	-	-	-	-
4	P18OEBA004	Cost Management Of Engineering Projects	3	0	0	3
5	P18OEME005	Composite Materials	3	0	0	3
6	P18OEEE006	Waste To Energy	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	0	0	3

AUDIT COURSES I &II

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

Grand Total credits and contact hours

SEMESTER	I	II	III	IV	TOTAL
TOTAL CONTACT HOURS	24	26	26	32	**108**
CREDITS	18	18	16	16	**68**

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		
1.	Professional Core (PC)	10	10			20	29.41
2.	Professional Electives(PE)	6	6	3		15	22.06
3.	Open Electives (OE)			3		3	4.41
4.	Project Work, Soft Skill etc. (PR)	2	2	10	16	30	44.11
	Total Credit	18	18	16	16	**68**	
	Total Contact Hour	24	26	26	32	**108**	100

P18PCBM101	ANATOMY AND PHYSIOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Biology (+2 level)				
	Course Coordinator Name & Department:-Dr.Emerson Solomon F. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand basics of Human Anatomy and Physiology.
- To study the organs and systems involved in body functions.
- To apply the knowledge gained about the organ functions, reflexes, and special senses into biomedical engineering field.

COURSE OUTCOMES (COs)

CO1	Learn the basic terminologies, structural and functional elements of human body
CO2	Learn the physiological aspects of respiratory and cardiac system
CO3	Learn the structure and function of nervous tissue, visual and auditory pathways
CO4	The process of temperature regulation; understand the process of GI reflex
CO5	Attain a good knowledge on the role of hormones and functions of Endocrine gland
CO6	Learn the anatomical features of organs to construct medical 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	2	3	1	3	2	2	2	2						1
	CO2	2	3	1	3	2	2	2	2						
	CO3	2	3	1	3	2	2	2	2						
	CO4	2	3	1	3	2	2	2	2						
	CO5	2	3	1	3	2	2	2	2						
	CO6	2	3	1	3	2	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)
					✓					

4	Approval	47th Meeting of Academic Council, Aug 2018

UNIT I CELL PHYSIOLOGY

9

Cell structure, Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Recording of Action potentials, patch clamp, Action potential in nerve, Muscle and Heart.

UNIT II GASTROINTESTINALAND RESPIRATORY SYSTEM

9

Structure of gastrointestinal system, layers in Gastro-intestinal System (deglutition, Peristalsis) movement in stomach, small intestine and movements in GI tract and factors regulating the movement. Respiratory pathway, volumes capacities and measurement, respiratory centers and its regulation of respiration, Artificial Respiration

UNIT III ENDOCRINE AND NEURAL REFLEXES

9

Mention of Endocrine glands general hormonal action, Second messengers, anterior and posterior pituitary hormones. Components in a Simple reflex. Structure of kidney and micturition reflex, Cystometerogram.

UNIT IV CARDIOVASCULAR AND SPECIAL SENSES 9

Structure of Heart, conducting pathway and ECG, BP and its measurements. Structure of Eye and Ear, errors of refraction, photochemistry of vision and visual pathway, Middle Ear mechanics, organ of Corti and Auditory pathway, Audiometers**.**

UNIT V NERVOUS SYSTEM

9

Neuron, properties of Synapse, Cross section of spinal cord, ascending and descending tracts, EEG, Automatic nervous system, body temperature regulation. Cortical functions.

REFERENCES

1. Guyton „Text book of Medical Physiology – WB Jaunder company Philadelphia - 10 edition 2002
2. Cyrul A Keele and Eric Neil – Samsons Wrights Applied physiology – Oxford University press New Delhi – 1991
3. Ranganathan T S,Text Book of human Anatomy S. Chand and company New Delhi – 1994
4. Best and Taylor, The livery Body – BC publication New Delhi 1980

P18PCBM102	**ADVANCE IN BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3

		Prerequisite course – Basic Instrumentations
		Course Coordinator Name & Department:-Mr.Prasath S. & 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

COURSE OUTCOMES (COs)

CO1		Explain about measurements of parameters related to respiratory system
CO2		Describe the measurement techniques of sensory responses
CO3		Analyze different types and uses of diathermy units
CO4		Discuss ultrasound imaging techniques and its usefulness in diagnosis
CO5		Outline the importance of patient safety against electrical hazard
CO6		The application of patient monitoring 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	PSO2
2	CO1	3	3			2			2	2		2			3
	CO2	3	3	3	3	3			3	3	3	3			
	CO3	3	3	2	2	2			2		2				
	CO4	3	3		3	3				3		3			
	CO5	3	3			2			2	2					
	CO6	3	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)
					✓					

4	Approval		47th Meeting of Academic Council, Aug 2018

UNIT I - ELECTRO PHYSIOLOGICAL MEASUREMENTS 9

Electrodes –Limb electrodes –floating electrodes – pre-gelled disposable electrodes – Micro-, needle- electrodes – Amplifiers – Differential amplifiers, Instrumentation amplifier, Chopper amplifiers – Isolation amplifier. ECG, EEG, EMG - Lead systems and recording methods.

UNIT II - BLOOD GAS ANALYZERS AND OXIMETERS

9

Blood pH measurement- Blood pCO2 measurement- Blood pO2 measurement- intra arterial - complete blood gas analyzer – Oximetry - Principle, ear, pulse, skin reflectance, intravascular oximeter.

UNIT III- PATIENT MONITORING SYSTEMS

9

Patient monitoring system-Bedside, Central monitoring, Measurement of heart rate, pulse rate, blood pressure-Direct-, and indirect- methods, temperature, respiration rate, catheterization laboratory instrumentation

UNIT IV - EAR AND OPTHALMOLOGICAL EQUIPMENTS

9

Ear: Hearing loss, Sound conduction system, Basic audiometer - Pure tone audiometer - Audiometer system-Bekesy - Evoked response audiometer system - Hearing aids. Vision: Visual acuity - Errors in vision slit lamp, Tonometer, Ophthalmoscope, Perimeter.

UNIT V – CLINICAL LAB INSTRUMENTS

9

Introduction-medical diagnosis with chemical test – Spectrophotometer – Colorimeter - Auto analyzers - clinical flame photometer - selective ion based electrolytes - Electrical safety in medical environment - shock hazards – leakage current-safety codes-electrical safety analyzer - testing of biomedical equipments.

REFERENCES

1. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, 2nd Edition, Tata McGraw Hill, 2003.

2. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer “Biomedical Instrumentation and Measurements““, Prentice Hall of India, 2011. 8

3. Joseph J. Carr and John M Brown, “Introduction to Biomedical Equipment Technology”, 4 th edition, Pearson Education, 2008.

4. John G.Webster (editor), “Bioinstrumentation”, John Wiley & Sons, 2004.

5. Joseph Bronzino, “Biomedical Engineering & Instrumentation”, Taylor & Francis, 3rd edition, 2006.

6. Ronald Pitts Crick, Pang Khaw “Text book of clinical Ophthalmology”, 2nd Edition, World Scientific publication. ISBN 981- 238-128-7.

P18PRBM101	**BIO-RESEARCH METHODOLOGY & IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	2	0	0	2
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

- Student will understand research problem formulation and Analyze research related information

Unit 1: RESEARCH CONCEPTS

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantificationof Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

Unit 2: DATA ANALYSIS AND INTERPRETATION

Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit 3: REPORT WRITING

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: NATURE OF INTELLECTUAL PROPERTY

Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications, Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCE BOOKS:

1. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson , 2000
3. L.P. Singh , "Advanced Power System Analysis and Dynamics", New Age International, 2006
4. G.L. Kusic, "Computer aided power system analysis" ,Prentice Hall India, 1986
5. A.J. Wood, " Power generation, operation and control" , John Wiley, 1994

P18PCBM1L1	**ADVANCE BIO MEDICAL INSRUMENTATION LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite course – NIL				
	Course Coordinator Name & Department:- Mr.Prasath S. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To provide practice on recording and analysis of different Bio potentials
- Study the function of different Therapeutic equipment‟s.

COURSE OUTCOMES (COs)

CO1	IC circuits, Op-amps, rectifiers and its applications
CO2	Safety concerns in hospitals
CO3	Use of filters in biomedical applications
CO4	Different types of read-out devices used
CO5	Use of timers and counters
CO6	The applications of amplifiers in instrumentation

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	3	2	3	2	2			2	2		2			3
	CO2	2	2	3	2	3			2	3	2				
	CO3	3	2	2	3	2			3		2	3			
	CO4	3	3	2	3	2			2	3	3	2			
	CO5	2	3	3	3	3				2		3			
	CO6	2	3	3	3	3			2	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)
					✓					

4	Approval	47th Meeting of Academic Council, Aug 2018

LIST OF EXPERIMENTS

1. Construction and testing of Instrumentation amplifier
2. Design of Instrumentation amplifier using Single IC and Single supply
3. Patient monitoring system and Bio-telemetry.
4. Plotting of Human auditory response using audiometer.
5. Performance and testing of Surgical Diathermy unit using Diathermy analyzer.
6. Recording of Electromyogram.
7. Construction and testing of nerve stimulator.
8. Study of ECG machine.
9. Study of EEG machine.

P18PCBM1L2	ANATOMY AND PHYSIOLOGY LAB	L	T	P	C
	Total Contact Hours – 45	0	0	4	2
	Prerequisite course – NIL				
	Course Coordinator Name & Department:- Dr.Emerson Solomon F. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand basics of Human Anatomy and Physiology.
- To study the organs and systems involved in body functions.
- To apply the knowledge gained about the organ functions, reflexes, and special senses into biomedical engineering field.

COURSE OUTCOMES (COs)

CO1	Learn the basic terminologies, structural and functional elements of human body
CO2	The physiological aspects of respiratory and cardiac system
CO3	Learn the structure and function of nervous tissue, visual and auditory pathways
CO4	Analyze the process of temperature regulation; understand the process of GI reflex
CO5	Attain a good knowledge on the role of hormones and functions of Endocrine gland
CO6	The features of blood in clotting and bleeding time

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	3	2	3	2	2			2	2		2		1	
	CO2	2	2	3	2	3			2	3	2				
	CO3	3	2	2	3	2			3		2	3			
	CO4	3	3	2	3	2			2	3	3	2			
	CO5	2	3	3	3	3				2		3			
	CO6	2	3	3	3	3			2	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)
					✓					

4	Approval	47th Meeting of Academic Council, Aug 2018

LIST OF EXPERIMENTS

1. Determination of Blood group
2. Differential Count Of WBC
3. Estimation Of Haemoglobin
4. Enumeration of WBC
5. Enumeration Of RBC
6. Determination Of Erythrocytes Sedimentation Rate
7. Determination of Bleeding time &Clotting Time
8. Osmotic Fragility of RBC
9. Determination of Blood Pressure
10. Study of the effects of Exercise on Cardiovascular and Respiratory system
11. Effect of Postural change on Blood pressure and pulse rate
12. ECG -Demonstration
13. Recording of Respiratory movements using Stethography
14. Examination of the Sensory system
15. Examination of the Reflexes

P18PCBM201	**MEDICAL IMAGE ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in image processing (B.Tech/B.E)				
	Course Coordinator Name & Department:-Ms.Kripa N & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the production of x-rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about the various medical Imaging techniques.
CO2	Students have various diagnostic applications of the medical imaging techniques.
CO3	Students will get the clear domain knowledge the image fundamentals and Image transforms
CO4	Study the image enhancement techniques
CO5	Study the image restoration procedures and image compression procedures.

CO6		Study the image visualizations													
	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	3		2	3				3			2		2	
	CO2						2								
	CO3	2			2						2				
	CO4			1											
	CO5				3				3						
	CO6	3		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)		
							✓								
4	Approval		47th Meeting of Academic Council, Aug 2018												

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 REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

REFERENCES

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.
4. Alfred Horowitz, „MRI Physics for Radiologists – A Visual Approach", Second edition Springer Verlag Network, 1991.
5. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006
6. John L.Semmlow,"Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
7. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

P18PCBM202	BIOMEDICAL SIGNAL ANALYSIS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Digital Signal Processing				
	Course Coordinator Name & Department:- Mr.Kishore K & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse
- response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multi-rate and adaptive

COURSE OUTCOMES (COs)

CO1	Apply DFT for the analysis of Digital Signals & Systems
CO2	Design IIR and FIR Filters
CO3	Characterize finite word length effect on filters
CO4	Design the Multi-Rate Filters
CO5	Apply Adaptive Filters to equalization
CO6	To learn the feature extraction of the time frequency

	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	3			2	3		2			2			2	
	CO2			2											
	CO3	2			3						2				
	CO4					3		3							
	CO5	3									3				
	CO6			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)		
								✓							
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals,

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation,

scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

REFERNCES

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, „Biomedical Signal Analysis-A case study approach", Wiley-Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002
5. Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.
6. K.P.Soman,K.I Ramachandran,"Insight into wavelet from theory to practice", PHI, New Delhi,2004
7. John L.Semmlow," Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
8. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing", CRC – Taylor and Francis,New York,2006
9. D.C.Reddy,"Biomedical Signal Processing – Principles and Techniques",TMH,New Delhi,2005
10. Gari D.Clifford, Francisco Azuaje and Patrick E.McSharry," Advanced Methods and Tech for ECG Data Analysis", ARTECH House,Boston,2006

P18PCBM2L1	**MEDICAL IMAGE ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite course – Knowledge in image processing (B.Tech/B.E)				
	Course Coordinator Name & Department:- Ms.Kripa N & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the production of x-rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about the various medical imaging techniques.
CO2	Students have various diagnostic applications of the medical imaging techniques.
CO3	Students will get the clear domain knowledge the image fundamentals and image transforms

CO4		Study the image enhancement techniques
CO5		Study the image restoration procedures and image compression procedures.
CO6		Study the x-ray features and 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	3	2	3			3			2					
	CO2					2									
	CO3	2		2					2					**2**	
	CO4		1								1				
	CO5				3				3						
	CO6	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)	
					✓						
4	Approval		47th Meeting of Academic Council, Aug 2018								

LIST OF EXPERIMENTS

1. Fundamentals of medical image analysis
2. Gray level transformation and histogram processing of X-ray images.
3. Noise removal and filtering in various medical images.
4. Pixel based segmentation of MRI images
5. Edge based segmentation of CT images.
6. Morphological operations on x-ray images.
7. Statistical feature extraction on X-ray and CT images.
8. Medical Image registration.
9. Vessel extraction in angiographic images using MIMICS software.
10. Geometrical measurements in Medical images using MIMICS software

P18PCBM2L2	**BIOMEDICAL SIGNAL ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Digital Signal Processing				

		Course Coordinator Name & Department:- Ms.Kishore K & Department. of Biomedical Engineering

COURSE OBJECTIVES:-

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse
- response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multi-rate and adaptive

COURSE OUTCOMES (COs)

CO1		Apply DFT for the analysis of Digital Signals & Systems
CO2		Design IIR and FIR Filters
CO3		Characterize finite word length effect on filters
CO4		Design the Multi-Rate Filters
CO5		Apply Adaptive Filters to equalization
CO6		Learn the designing of 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	3			2	3		2			2			2	
	CO2			2											
	CO3	2			3						2				
	CO4					3		3							
	CO5	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)
						✓				

4	Approval		47th Meeting of Academic Council, Aug 2018

LIST OF EXPERIMENTS

1. Representation of basic signals
2. Linear convolution
3. Autocorrelation and cross correlation
4. FFT and IFFT Difference equation

5. Representation Digital IIR
6. Butterworth filter-LPF & HPF
7. Digital IIR chebychev filter-LPF & HPF
8. Design of FIR filter using windowing technique
9. Upsampling and downsampling
10. Analysis of ECG
11. Analysis of EEG
12. Analysis of PCG

PROFESSIONAL ELECTIVE

P18PEBM011	ADVANCED BIOSENSOR AND TRANSDUCERS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic knowledge of electronic devices and sensors				
	Course Coordinator Name & Department:- Mr.Prasath S. & 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.

COURSE OUTCOMES (COs)

CO1	Describe the purpose and methods of measurements
CO2	Explain different display and recording devices for various applications.
CO3	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications
CO4	Remember and understand the concepts, types, working and practical applications of important biosensors.
CO5	Know some of the commonly used biomedical transducers
CO6	Learn to apply the application based n biosensors in medical 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														
	CO2			3	3		2								3
	CO3		2	3	3		3								

	CO4	3	2	3	3										
	CO5			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)		
								✓							
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT - I CHEMICAL SENSORS 9

Blood –Gas and Acid –base physiology Electrochemical sensors, Chemical Fibro sensors, Iron-Selective Field-Effect Transistor (ISFET), Immunologically Sensitive Field Effect Transistor (IMFET) , Integrated flow sensor and Blood Glucose sensors.

UNIT - II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics - accuracy, precision, sensitivity, linearity etc - mathematical model of transducers - zero first - order and second - order transducers - response to impulse step, ramp and sinsoidal inputs.Non polarizable electrodes and body surface recording electrodes. Ultrasonic Transducers for Measurement and therapy – radiation detectors – NIR spectroscopy .

UNIT - III BIOMEDICAL SENSORS 9

Sensors Terminology in human body, Introduction, Cell, Body Fluids Musculoskeletal system, Bioelectric Amplifiers, Bioelectric Amplifiers for Multiple input Circuits, Differentional Amplifiers, Physiological Pressure and other cardiovascular measurements and devices.

.

UNIT – IV BIOSENSORS - PHYSIOLOGICAL RECEPTORS - J RECEPTORS 9

Chemo receptors, Baroreceptors, Touch receptors, Biosensors - Working Principle and Types, Applications.

UNIT – V ADVANCED SENSOR DESIGN 9

Fluoroscopic machines design, Nuclear medical systems, EMI to biomedical sensors, types and sources of EMI, Fields, EMI effects. Computer systems used in Xray and Nuclear Medical equipments. Calibration, Typical faults, Trouble shooting, Maintenance procedure for medical equipments and Design of 2& 4 wire transmitters with 4 – 20 mA output.

Text Book

1. Sensors Hand Book Sabaree Soloman - Sensors Hand Book, McGraw Hill,1998
2. Smith H.M. - Principles of Holography, John Wiley & Sons, New York, 1975
3. J.G. Webster Medical instrumentation Application and Design, Houghton Mifilin Co. 2004

References

1. Carr and Brown - Introduction to Medical Equipment Technology, Addison Wesley. 1999
2. Culshaw B and Dakin J (Eds) Optical Fibre Sensors, Vol. 1 & 2 Artech House, Norwood. (1989)-
3. P. Garnell– Guided Weapon Control Systems – Pergamon Press. 1980

P18PEBM012	ADVANCE MATHEMATICS FOR BIOMEDICAL ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Engineering Maths Knowledge				
	Course Coordinator Name & Department:- Mr.Kishore K & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

To encourage students to develop a working knowledge of the central ideas of linear algebra; notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains and To provide the student with the concept and an understanding of basic concepts in Linear Programming techniques, Duality Principles, Transportation and Assignment problems, PERT/CPM.

COURSE OUTCOMES (COs)

CO1	To understand the matrices and some applications.
CO2	To understand the Geometric, Uniform, Exponential, Gamma
CO3	To understand the linear program
CO4	Apply the concepts of Transportation Problem and Assignment Problem, participate in the class room discussion on Transportation algorithm.
CO5	Explain and demonstrate the basic concepts of PERT- CPM and their application, reproduce the network model.
CO6	To learn about the Random processed 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	3	3	2	2	3					1	3		2	
	CO2	3			3	3					2	3			
	CO3	3	3	3							3	3			
	CO4	3	2	2					1	2	1	2			
	CO5	3			3	2			2	2	2	1			
	CO6	3	2	2					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)		
							✓								
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT I LINEAR ALGEBRA 9

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II RANDOM PROCESSES 9

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process –- Markov chain - Poisson process – Gaussian process.

UNIT III LINEAR PROGRAMMING 9

Formulation – Graphical solution – Simplex method – Two phase method

UNIT IVTRANSPORTATION &ASSIGNMENT PROBLEMS 9

Transportation models – Vogel‟s approximation method MODI method – Unbalanced transportation problem – Degeneracy in transportation models - Assignment problems – Hungarian method

UNIT V NETWORKS & REPLACEMENT MODELS 9

Networks – PERT and CPM – Network diagrams – Shortest route – Minimum spanning tree, Replacement models– Individual and Group replacement policy

REFERENCES:

1. Andrews,L.C. and Philips.R.L. “Mathematical Techniques for engineering and scientists”, Printice Hall of India,2006.
2. O‟Neil P.V. “Advanced Engineering Mathematics”, (Thomson Asia Pvt Ltd, Singapore) 2007, cengage learning India private limited.
3. Kanti Swarup, Gupta P.K., and Manmohan, “Operations Research”, Sultan Chand &

Sons 1997. Paneerselvam R., Operations research, Prentice-Hall of India, New Delhi, 2001.
4. T. Veerarajan, "Operations Research", Published by Orient Black Swan, 2010.
5. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.

P18PEBM013	COMPUTER BASED MEDICAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Medical Instrumentations				
	Course Coordinator Name & Department:- Ms.Vinodini R. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- Computer assisted instruction in education, including biomedical engineering education, has been explored and changed dramatically for more than two decades.
- The Internet, with its capacity to transmit synchronous and asynchronous audio, text, and graphics, presents educators with tremendous opportunities for distance education and independent learning.
- In this work, we have developed a new educational hypermedia for medical instrumentation courses

.

COURSE OUTCOMES (COs)

CO1	About computer hardware components and its interface
CO2	Different microprocessors and its architecture
CO3	Pentium processors and its architecture
CO4	Telemedicine and applications
CO5	Biometric systems in use today.
CO6	Understand the network 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	3		3				3			2				
	CO2					2									
	CO3	2		2											
	CO4		1									1			3
	CO5							3							
	CO6	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)
						✓				
4	Approval	47th Meeting of Academic Council, Aug 2018								

UNIT I PC HARDWARE AND OVERVIEW 9

Hardware – BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board – I / O slots – Mother Board logics- Memory and I/O map, Peripheral interfacing and controllers- Serial and Parallel interface – CRT Display Adapter – FDC – HDC – PC buses

UNIT II 80186, 80286, 80386 AND 80486 MICROPROCESSORS 9

80186 Architecture, Enhancements of 80186 – 80286 Architecture – Real and Virtual Addressing Modes – 80386 Architecture – Special Registers – Memory Management – Memory Paging Mechanism – 80486 Architecture – Enhancements – Cache Memory Techniques – Exception Handling – Comparison of Microprocessors (8086 – 80186 – 80286 – 80386 – 80486).

UNIT III PENTIUM MICROPROCESSORS 9

Pentium Microprocessor Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II Microprocessor Architecture – Pentium III Microprocessor Architecture – Pentium III Architecture – Pentium IV Architecture – Comparison of Pentium Processors.

UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING 9

Plug-in-data acquisition and Control Boards, Data acquisition using GPIB and Serial Interfaces and Programming in C, Virtual reality – Multimedia - Telemedicine – Computers in Critically Care Units and radiological centres

UNIT V BIOMETRICS FOR NETWORK SECURITY 9

Introduction to Biometrics and its characteristics, Finger print technology, feature extraction and classification, Face recognition and hand geometry - feature extraction and classification, Biometric authentication system

REFERENCES

1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata

McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

P18PEBM021	TISSUE ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course –				
	Course Coordinator Name & Department:- Dr.Vasukidevi R & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the Tissue Exchange and Tissue Development.
- To know the Cell growth and differentiation, Cell and tissue mechanism.
- To study the cell adhesion, cell migration, cell aggregation and tissue equivalent.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Tissue engineering, Element of Tissue development.
CO2	Learn the Cell and tissue mechanism, cell adhesion, cell migration, cell aggregationand tissue equivalent.
CO3	To learn Delivery molecular agents in tissue engineering, control releaser agents intime and space.
CO4	To learn cell interaction with polymer cell, cell interaction with polymer insuspension, cell interaction with gels.
CO5	Study the Replacement in Tissue structure or Functional Tissue engineering cartilage.
CO6	To understand the tissue generation

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	3		3				3			2				
	CO2					2									
	CO3	2		2											
	CO4		1									1			2
	CO5							3							
	CO6	1		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)		
								✓							
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT I FUNDAMENTAL OF TISSUE ENGINEERING 9

Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development.

UNIT II CELLULAR STUDIES 9

Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

UNIT III TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT
9

Cell delivery and recirculation, Delivery molecular agents in tissue engineering,control releaser agents in time and space.

UNIT IV INTRODUCTION TO POLYMERS 9

Non degrade polymer, Bio degradable polymer, cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.

UNIT V APPLICATION OF TISSUE ENGINEERING 9

Artificial organs, synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin, and nerve regeneration.

REFERENCES

1. W Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press inc New York 2004
2. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.

P18PEBM022	**BIOMATERIALS ANDIMPLANTABLE DEVICES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Biomaterials (B.Tech)				
	Course Coordinator Name & Department:- Ms.Geetha & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study about the artificial organs and various medical materials like implant materials, polymeric implants, tissue replacement implants and its applications.

COURSE OUTCOMES (COs)

CO1	To understand the basic definition and classification of various biomaterials
CO2	To learn the properties of various biomaterials, metallic implants and alloys
CO3	To apply the mechanical properties of various materials in therapeutic applications
CO4	To get introduced about different artificial organs

CO5		To understand the properties of bio glass, bio ceramics and biopolymers.													
CO6		To understand the neuro muscular implants													
	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	3	2		3				3			2			
	CO2						2								
	CO3	2			2						2				
	CO4		1												3
	CO5														
	CO6	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)		
							✓								
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT-I **9**

Definition and classification of Biomaterials, Metallic implant materials- Ceramic implant materials- Polymeric implant materials, composites

UNIT-II **9**

Biocompatibility- interfacial phenomena, Material response function and degradation of materials, in vivo- host response - Methods of test for biological performance.

UNIT-III **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. Orthopaedic implants- Hard tissue replacements- total hip and knee joint replacements

UNIT-IV **9**

PhysioChemical Characteristics of Biopolymers- biodegradable polymers for medical purposes- synthetic polymers,biopolymers in Controlled release systems. Artificial skin, surface Modification of biopolymer materials.

UNIT-V **9**

Cardiac Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses**,**Dental implants.

REFERENCES

1. Park. J.B. "Biological science and engineering", Plenum Press, 1994.
2. Jonathan Black "Biological Performance of Materials', Marcel Dekker", 1981.
3. Piskin.E. & Hoffmann.A.S. "Polymeric biomaterials" Martinus Nijihoff pub, 1986
4. "Biomaterials", Sujata V Bhat., Narosa Publishing House, New Delhi, 2002
5. *Park. J.B. "Biomaterials: An Introduction", CBS Publishers, 2007.*
6. F.H. Silver, "Biomaterials, Medical Devices and Tissue Engineering: An Intergrated Approach" 1st Edn., Chapman & Hall, London, 1994.
7. Buddy Ratner *etal.*, " Biomaterials Science – An Introduction to Materials in Medicine", Academic Press, San Diego, 2004.

P18PEBM023	**PHYSIOLOGICAL MODELING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – basic knowledge anatomy& physiology (B.Tech/B.E)				
	Course Coordinator Name & Department:- Mr.Kishore K & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the concept and different mathematical techniques applied in analyzing any given system
- To learn the analysis of given system in time domain and frequency domain
- To study the stability analysis of the given system

COURSE OUTCOMES (COs)

CO1	Analyze the time and frequency domains of the given system using different mathematical techniques
CO2	Learn the basics of control systems
CO3	Time and frequency response analysis
CO4	Bio-control system definition and modeling
CO5	Study the model of eye, respiratory system, etc
CO6	To Understand the working of physiological model

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		2				3				2			
	CO2				3				2						
	CO3		2			2		3		3		2			
	CO4			2											2
	CO5	3		2		2	2					2			
	CO6	1		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)
						✓				
4	Approval	47th Meeting of Academic Council, Aug 2018								

UNIT I INTRODUCTION 9

System Concept, System Properties, Piece-Wise Linear Approximation, Electrical Analog for Compliance, Thermal Storage, Mechanical Systems, Step response of a Resistance/Compliant Systems, Pulse Response of First Order System.

UNIT II TRANSFER FUNCTION 9

System as an Operator use of Transfer Function, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT III PERIODIC SIGNALS 9

Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Function s from Frequency Response, Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system, General Description of Natural Frequency Damping, Physical Significance of Under Damped Responses.

UNIT IV FEEDBACK 9

Characterization of physiological feedback systems, uses and testing of system stability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9

Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

REFERENCES

1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.
2. ManfreoClynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.
3. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William

and Wilkins Co, Baltimore, 1970 .
4. Richard Skalak and ShuChien, Hand Book of Biomedical Engineering, McGraw Hill and Co, New York, 1987.
5. Michael C.K. Khoo, "Physiological Control System" - Analysis, Simulation and Estimation"- Prentice Hall of India, New Delhi, 2001

P18PEBM031	BIO MEMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in Microprocessor (B.Tech/B.E)				
	Course Coordinator Name & Department:- Mr.Prasath S. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the Working principle of Microsystems.
- To know System modeling and properties of materials.
- To study the Fundamental principle of MOEMS technology.

COURSE OUTCOMES (COs)

CO1	To learn objectives of materials for MEMS and Microsystems and micromachining.
CO2	Learn the Peltier effect heat pumps and thermal flow sensor.
CO3	To learn digital micromirror devices, light detectors, optical switch.
CO4	To learn expression for liquid flow in a channel.
CO5	Study the micro system approaches to polymerase chain reaction (PCR).
CO6	To understand the applications of mems in medical 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	3	3	2				3			2				
	CO2				3				3			2	3		
	CO3		2				2	3			2				
	CO4			2					3						3
	CO5	3					2	2				2	3		
	CO6		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)

						✓				
4	Approval		47th Meeting of Academic Council, Aug 2018							

UNITI MEMS AND MICROSYSTEMS 9

Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

UNIT II MICROSENSORS AND ACUATORS 9

Mechanical sensors and actuators – beam and cantilever, piezoelectric materials, thermal sensors and actuators- micromachined thermocouple probe, Peltier effect heat pumps, thermal flow sensors, Magnetic sensors and actuators- Magnetic Materials for MEMS, Devices

UNIT III MICRO OPTO ELECTRO MECHANICAL SYSTEMS 9

Fundamental principle of MOEMS technology, light modulators, beam splitter, microlens, digital micromirror devices, light detectors, optical switch

UNIT IV MICROFLUIDIC SYSTEMS 9

Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system

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

REFERENCES

1. Tai Ran Hsu , " MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. NitaigourPremchandMahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Wanjun Wang, Steven A.Soper " BioMEMS- Technologies and applications", CRC Press,Boca Raton,2007
4. Abraham P. Lee and James L. Lee, BioMEMS and Biomedical Nano Technology, Volume I, Springer 2006.

P18PEBM032	HEALTH HOSPITAL AND EQUIPMENT MANAGEMENT	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in Microprocessor (B.Tech/B.E)				
	Course Coordinator Name & Department:- Dr.Vasuki R. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To expose the students for planning and operation of hospitals in a detailed mannerwhich will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.
- To introduce the equipment maintenance management skills and how to protect equipment from electromagnetic interferences.

COURSE OUTCOMES (COs)

CO1	Expert in understanding the various health policies
CO2	Planning activities at health care centres.
CO3	Equipment installation ,service & calibration needs
CO4	Organizing maintenance operations
CO5	Function of a clinical engineer in a hospital
CO6	Learning the hospital safety and applicaions

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	3	3	2			3			2				2	
	CO2				3			3			2	3			
	CO3		2			2	3			2					
	CO4			2				3							
	CO5	3				2	2				2	3			
	CO6	2	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)
						✓				

4	Approval		47th Meeting of Academic Council, Aug 2018

UNIT IHEALTH SYSTEM **9**

Health organisation 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 Organisation, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of 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, IRPQ.

UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT **9**

Organising Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance.

UNIT V TRAINED TECHNICAL PERSONNEL **9**

Function of Clinical Engineer, Role to be performed in Hospital, Manpower Market, Professional Registration, and Structure in Hospital.

REFERENCES

1. Cesar A.Caceres and Albert Zara,The Practice of Clinical Engineering, Academic Press, New York,1977.
2. Webster.J.G. and Albert M.Cook,Clinical Engineering Principles and Practices Prentice Hall Inc. ,Englewood Cliffs, New Jersey, 1979.
3. Hans Pfeiff,VeraDammann (Ed.),Hospital Engineering in Developing Countries, Z Report, Eschbom,1986
4. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. SanDeigo1988
5. R.C.Goyal, Human Resource Management in Hospital, Prentice Hall of India, 3rd edition,2000.
6. Syed Amin Tabish “Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001

	TELEHEALTH TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3

P18PEBM033		Prerequisite course – Knowledge in Microprocessor (B.Tech/B.E)
		Course Coordinator Name & Department:- Dr.Vasuki R. & Department. of Biomedical Engineering

COURSE OBJECTIVES:-

- To study the Series History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine.
- To know Social and legal issues, Safety and regulatory issues and Advances in Telemedicine.

COURSE OUTCOMES (COs)

CO1		To learn objectives of Tele health, Tele care and Organs of telemedicine**.**
CO2		Learn the Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications.
CO3		To learn Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320series (Video phone based ISBN).
CO4		To learn Basic parts of teleradiology system.
CO5		Introduction to robotics surgery, tele surgery, Tele cardiology and Teleoncology
CO6		To understand the applications of telemedicine

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		2				3				2		2	
	CO2				3				2						
	CO3		2			2		3		3		2			
	CO4			2											
	CO5	2		2		2	2					2			
	CO6		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)
						✓				

4	Approval		47th Meeting of Academic Council, Aug 2018

UNIT I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Functional diagram of telemedicine system,

Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, 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 (www). Video and audio conferencing.clinical data–local and centralized

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available.Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self-care, Business aspects - Project planning and costing, Usage of telemedicine.

REFERENCES

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
4. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS

Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
5. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
6. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

7. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
8. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
9. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
10. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
11. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

P18PEBM041	**ADVANCED NEURAL COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – knowledge on neural networks (B.Tech/B.E)				
	Course Coordinator Name & Department:- Mr.Kishore K & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- The course will teach a variety of contemporary approaches to neural networks and introduce the theory underlying these approaches.
- The approaches to be covered will include such things as biological and statistical foundations of neural networks, Perception, MLPs, RBFN, SVM and competitive learning.
- Additionally, a brief introduction to optimization techniques using Genetic algorithm and its applications will be given.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course student gains knowledge about various neural networks that can be used for biomedical signal analysis and Medical image analysis.
CO2	About the genetic algorithms as well as techniques used in its implementation
CO3	Examinations of human central nervous systems inspired the concept of artificial neural network.
CO4	Applications in ANN
CO5	Capability of approximating non linear functions of their
CO6	To Understand the applications of Neural networks in medical 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	3	3	2			3			2				3	
	CO2				3			3			2	3			
	CO3		2			2	3			2					
	CO4			2				3							
	CO5	3				2	2				2	3			
	CO6		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)		
								✓							
4	Approval		47th Meeting of Academic Council, Aug 2018												

UNIT I FUNDAMENTAL CONCEPTS AND MODELS OF ARTIFICIAL NEURAL SYSTEMS 9

Biological Neurons and their artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II BPN AND BAM 9

Back Propagation Network, Generalized Delta Rule, BPN Application, Associative Memory Definition, BAM, Hopfield Memory, Simulated Annealing-Boltzmann Machine.

UNIT III OTHER NETWORKS 9

Counter Propagation Network, Feature Mapping, Self-Organizing Feature Maps, Adaptive Resonance Theory (ART) Network Descriptions,

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 10

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling

UNIT V ADVANCES AND APPLICATIONS 8

Support Vector Machines, R B F Network, Neocognitron Evolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

REFERENCES

1. Philip D.Wasermann, Advanced Methods in neural Computing, Van NostrandReinhold,NewYork 1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison - Wesley USA,1997.
3. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998. .
4. Simon Haykins, Neural Networks ,Prentice Hall international lnc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley, India 1999.

P18PEBM042	NUCLEAR MEDICINE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in Biomedical Equipments (B.Tech/B.E Level)				
	Course Coordinator Name & Department:- Dr.Emerson Solomon F. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- This course is designed to prepare graduates to function as technologists in nuclear medicine departments. This subject will enable the students to learn the basic principles of different imaging modalities used in nuclear medicine

COURSE OUTCOMES (COs)

CO1	To understand the basic physics of various imaging modalities in nuclear medicine.
CO2	To gain knowledge about various detectors used in nuclear medicine
CO3	To gain knowledge in maintenance, handling and operation of the various Equipments in this field.
CO4	To understand the basic working principle of Emission Tomography.
CO5	To understand the basic physics of various imaging
CO6	To learn the applications of nuclear 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	3		2	3				3			2		1	
	CO2						2								
	CO3	2			2						2				
	CO4			1											
	CO5				3				3						
	CO6	3		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)
					✓					
4	Approval	47th Meeting of Academic Council, Aug 2018								

UNIT I – BASIC PHYSICS BEHIND RADIOACTIVITY 9

Physics of Radioactivity: Radionuclide Decay Terms and Relationships – Activity – Physical half Life – Fundamental Decay Equation, Nuclear Transformation – Alpha Decay, Beta-Minus Decay-Beta Plus – Electron Capture – Isomeric Transition – Decay Schemes

UNIT II – PRODUCTION OF RADIOACTIVE ELEMENTS 9

Radionuclide Production: By cyclotron, nuclear reactor, neutron activation method, and generators, Radiopharmaceuticals – Characteristics, applications, quality control and regulatory issues in medical imaging, Radiopharmaceutical mechanisms of localization

UNIT II I RADIOACTIVITY DETECTORS 9

Radionuclide detection and measurement - Type of detectors – pulsed and current mode - spectroscopy, Gas Filled detectors, Scintillation detectors, Semiconductor detectors, Pulse height spectroscopy, Non– imaging detector applications, Counting statistics

UNIT IV – NUCLEAR IMAGING 9

Planar Nuclear Imaging: Anger Scintillation Camera – Design and principles of operation-performance – design factors, Computers in Nuclear Imaging – Digital image formats – image acquisition – Image processing in nuclear medicine

UNIT V – EMISSION TOMOGRAPHY AND APPLICATIONS 9

Nuclear Imaging Emission Tomography: Focal plane tomography - Single photon emission computed tomography (SPECT) – image acquisition – Image reconstruction – attenuation correction in SPECT, Positron emission tomography – Design and principles of operation – 2-D and 3-D acquisition – Comparison of SPECT and PET – Combines X-ray CT and SPECT – Applications: Whole body, Heart and Brain. 40

REFERENCES

1. Jerrold T Bushberg, J.Anthony Seibert, Edwin M Leidholdt,John M Boone, Lippincott, “The Essential Physics of Medical Imaging” Williams & Wilkins,3rd edition,2011.
2. S Webb, “The Physics of Medical Imaging”, Adam Highler, Bristol Published by CRC Press, first edition 1988.
3. Webb‟s, “Physics of Medical Imaging”, Taylor and Francis Group”, CRC Press,2nd edition, 2012.
4. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill, 2nd edition,

2003.

P18PEBM043	BRAIN CONTROL INTERFACES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – knowledge on neural networks (B.Tech/B.E)				
	Course Coordinator Name & Department:- Ms.Kripa N. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the concept and different mathematical techniques applied in analyzing any given system
- To learn the analysis of given system in time domain and frequency domain
- To study the stability analysis of the given system

COURSE OUTCOMES (COs)

CO1	To learn EEG Data Acquisition ,Pre-processing ,Hardware and Software and Artifacts
CO2	Study the Case Study of Brain Actuated Control of Khepera Mobile Robot.
CO3	Learn the Movement Related EEG Potentials and Mental States and Visual EvokedPotential Based – P300 component.
CO4	To learn Laplacian Filters their Linear and Non-linear Features.
CO5	To learn Vector Quantization and Gaussian Mixture Modeling.
CO6	To Understand the Interface between the brain in instruments in external environemnt

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	3	3	2			3			2				2	
	CO2				3			3			2	3			
	CO3		2			2	3			2					
	CO4			2				3							
	CO5	3				2	2				2	3			
	CO6			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)
						✓				
4	Approval	47th Meeting of Academic Council, Aug 2018								

UNIT I INTRODUCTION TO BCI 8

Concept of BCI – Invasive and Non-invasive Types – EEG Standards – Signal Features – Spectral Components – EEG Data Acquisition – Pre-processing – Hardware and Software – Artifacts – Methods to Remove – Near Infrared BCI.

UNIT II BCI APPROACHES 9

Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

UNIT III EEG FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering – PCA – Laplacian Filters – Linear and Non-linear Features.

UNIT IV EEG FEATURE TRANSLATION METHODS

9

LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

UNIT V CASE STUDY 9

Case Study of Problems in BCI Competition III(2005) – Dataset I, II, III, IV and V – Solutions.
Case Study of Brain Actuated Control of Khepera Mobile Robot.

REFERENCES:

1. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
2. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002
3. R.Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981. ArnonKohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, ocaRato, Florida.
4. Bishop C.M, "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995
5. TorstenFelzer, "On the possibility of Developing a Brain Computer Interface", Technical Report, Technical University of Darmstadt, Germany, 2001.

	PRINCIPLES OF GENETIC ANALYSIS	L	T	P	C
P18PEBM051	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Basic Knowledge on genetic (B.Tech/B.E)				
	Course Coordinator Name & Department:- Dr.R. Vasukidevi & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To study the Pattern of inheritance and Chromosomal basis of inheritance.
- To know DNA sequencing, DNA Amplification.

- To study the Protein synthesis and regulation of gene expression.

COURSE OUTCOMES (COs)

CO1	To learn objectives of Chromosome mapping by recombination , Genetics of Bacteria and viruses.
CO2	Learn the DNA structure and replication, DNA sequencing, DNA Amplification and DNA Hybridization.
CO3	To learn Gene isolation and manipulation.
CO4	To learn Genetic basis of development.
CO5	Study the Quantitative Genetics and Evolution Genetics.
CO6	To understand the various Genomic expressions

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	3			2	3		2			2			3	
	CO2			2											
	CO3	2			3						2				
	CO4					3		3							
	CO5	3									3				
	CO6	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)
						✓				

4	Approval	47th Meeting of Academic Council, Aug 2018

UNIT I INHERITANCE - GENETIC ANALYSIS 9

Pattern of inheritance, Chromosomal basis of inheritance, Chromosome mapping by recombination, Genetics of Bacteriaand viruses.

UNIT II DNA AND PHENOTYPE 9

From Gene to Phenotype, DNA structure and replication- DNA sequencing, DNA Amplification, DNA Hybridisation and DNA Polymorphism, RNA transcription and processing, Protein synthesis and regulation of gene expression.

UNIT III GENOME STRUCTURE AND GENETIC ENGINEERING 9

Gene isolation and manipulation, Genomics, mutations, repair and recombination, site directed

mutagenesis, large-scale chromosomal changes and genetic polymorphism.

UNIT IV GENETIC PROCESSES 9

Gene function, Genetic organization, Genetic regulation, normal and cancer cells, Genetic basis of development

UNIT V IMPACT OF GENETIC VARIATION 9

Population Genetics, Quantitative Genetics, Evolution Genetics.

REFERENCES

1. Watson. J. etal, " Molecular Biology of the Gene ", 5th Edition, Pearson Publication, 2004.
2. Griffiths, Wesslers, Lewontin, Bart Gel, Suzuki, Miller "Introduction to Genetics Analysis", – W.H Freeman & company, New York 8th Edition - 2005.
3. Glick, B.R and J.J Pasternak "Molecular Biotechnology", Principles and application of Recombinant DNA" 3rd Edition ASM Press, 2003
4. Karp, Gerald." Cell and Molecular Biology". Concepts and Experiments, 4th Edition, John Wiley Sons, 2005.
5. Weaver. R.F. " Molecular Biology " 3rd Edition, McGraw – Hill, 2005.
6. Tom Strachan, Andrew P Read "Human molecular Genetics" 3rd Edition, Garland Publishing – 2004.

P18PEBM052	HUMAN ASSIST DEVICES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – basic knowledge signal processing (B.Tech/B.E)				
	Course Designed by – Dept. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To know the various biopotential recordings so as to enable students to record various biosignals.
- To know the various functional blocks present is 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 assist devices so as to enable the students to develop new assist devices.
- To introduce the recent trends in field of diagnostic and therapeutic equipments.

COURSE OUTCOMES (COs)

CO1	Explain about measurements of parameters related to respiratory system
CO2	Describe the measurement techniques of sensory responses

CO3		Analyze different types and uses of diathermy units
CO4		Discuss ultrasound imaging techniques and its usefulness in diagnosis
CO5		Outline the importance of patient safety against electrical hazard
CO6		Explain 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	PSO2
2	CO1	3		3				3			2			2	
	CO2					2									
	CO3	2		2											
	CO4		1									1			
	CO5							3							
	CO6	2				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)		
								✓							
4	Approval	47th Meeting of Academic Council, Aug 2018													

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

TOTAL = 45 PERIODS

REFERENCES

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.
3. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982
4. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
5. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.

P18PEBM053	**ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – basic knowledge signal processing (B.Tech/B.E)				
	Course Coordinator Name & Department:- Mr.Manoj Prasath T. & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To understand the significance of infections, biomedical waste and its proper disposal
- To teach the students about the controls applied to waste management.

COURSE OUTCOMES (COs)

CO1	What clinical engineering is all about and about hospital management
CO2	Types and importance of networking, different topologies and uses
CO3	Principles of fiber optic communication in hospital environment
CO4	Principles of EMI
CO5	Use of virtual environment in medicine
CO6	Understanding the usage of networking in medical 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	3		3				3			2				
	CO2					2									

	CO3	2		2									2	
	CO4		1								1			
	CO5						3							
	CO6	2				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)	
								✓						
4	Approval		47th Meeting of Academic Council, Aug 2018											

UNIT I CLINICAL ENGINEERING 9

Need for Standardization, Medical standards and recalibration, Hospital design, Hospital safety Regulations, hospital Management and Legal aspects.

UNIT II NETWORKING 9

Importance of networking, types of networking, LAN features, network topologies, LAN components, network operating system, basic data communication concept, application, LAN and multi-user system, planning and installing LAN in hospital set up.

UNITIII FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS 9

Different optical sources, optical detectors, principle of fiber optic cables, single mode, multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.

UNIT IV EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS 9

Principles of EMI, computation Of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this unit from interference

UNIT V VIRTUAL REALITY APPLICATION 9

Basic concepts of Virtual Environment , Human Factors and Human Perception, Computer graphics principles used in VR, Modeling of a Virtual Environment ,Existing tools, Avadars, Sensors for Perception, Tracking, Camera, Head mount display used in VR, Applications of Virtual Reality in Medicine

REFERENCES

1. Syed Amin Tabish "Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
2. Jacob Kline – Handbook of Biomedical Engineering Academe press INC Sandiego 1981.
3. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech House 3rd Edition, 1986.
4. Eric Udd, Fibre Optic Sensors and introduction for engineers and scientists,WileyInterscience Publication, New Delhi, 1991.
5. SK Basandia, Local Area Network,Golgotia Publishing Pvt. Ltd., New Delhi, 1995

OPEN ELECTIVE

P18OECS001 BUSINESS ANALYTICS

P18OECS001	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineer				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9

Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in 4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002 OPERATIONS RESEARCH

	OPERATIONS RESEARCH	**L**	**T**	**P**	**C**
P18OEMA002	Total Contact Hours – 45	3	0	0	3

	Prerequisite – Nil
	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES

- To apply the dynamic programming to solve problems of discreet and continuous variables.
- To apply the concept of non-linear programming.
- An ability to carry out the sensitivity analysis.
- An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques 9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method 9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM 9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming 9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical AnalysisandSimulation of Game Theory 9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEME003 INDUSTRIAL SAFETY

P18OEME003	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	0	0
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

Total No. of Periods: 45

References Books:

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.

P18OEBA004COST MANAGEMENT OF ENGINEERING PROJECTS

P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management 10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main

clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005 COMPOSITE MATERIALS

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineerin				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006 WASTE TO ENERGY

	WASTE TO ENERGY	**L**	**T**	**P**	**C**

P18OEEE006	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

P18OECE007 ENVIRONMENTAL HEALTH ENGINEERING

	ENVIRONMENTAL HEALTH ENGINEERING	L	T	P	C
P18OECE007	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Waste Management				
	Course Designed by – Dept of Civil Engineering				

Module I INTRODUCTION 9 Hours

Impact of Development and Water Pollution – Ecology and ecosystems Impact of development, land use and natural resource management, Cause and effects of environmental pollution

Module II SOURCES OF POLLTION 9Hours

Natural Processes: Pollution due to industrial, agriculture and municipal wastes – Limitation of disposal of dilution. BOD considerations in streams- Water Pollution control legislation.

Module III AIR POLLUTION 9 Hours

Air and Noise Pollution and Control- Pollutants and their sources- Effect of pollution of human wealth, vegetation- Air pollution control legislation -noise pollution- sources and effects – Control measures.

Module IV SOLID WASTE MANAGEMENT 9 Hours

Solid Wastes Management and Water Control Sources - Characteristics Quantities – Collection methods and disposal techniques - Sanitary -landfill -Incineration and pyrolysis – composting - water borne diseases – of mosquitoes, flies, rodents.Rational control and naturalistic methods of control, uses and limitations of pesticides, engineering measures of water control.

Module V FOOD SANITATION 9 Hours

Food & Milk Sanitation : Relation of food to disease – principles of food sanitation – Sanitation of Kitchen in restaurants and other catering establishments – Quality changes in milk – Milk as carrier of infection – Pasteurization of milk – HTST and LTLT processes. Cattle shed sanitation.

TEXT BOOKS

1. Ehlws V.M. and E.W. Steel. Municipal and Rural Sanitation – McGraw Hill Co. Inc, New York, 1954

REFERENCES

1. Park J.E. and Park K.,"Text Book of Preventing and Social Medicine",M/s. Banarsidos, Bhanot, Jabalpur, 1980.
2. Stern A.C. *ed,* "Air Pollution Vol. I, II & III", Academic Press, New York, 1968
3. Cuniff P.E,"Environmental Noise Pollution", John Wiley & Sons, New York. 1977.

P18OEBT008 BIO ENTREPRENEURSHIP DEVELOPMENT

P18OEBT008	BIO ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Bioprocess, genetic engineering, TQM				
	Course Designed by – Dept of Industrial Biotechnology				

Module I ENTREPRENEURSHIP FUNDAMENALS 9 Hours

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

Module II DECISION MAKING AND TIME MANAGEMENT 9 Hours

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

Module III ENTREPRENEURSHIP – FINANCE AND ECONOMIC FEASIBILITY 9 Hours

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

Module IV COMPANY LAWS AND REGULATIONS 9 Hours

Forming companies– Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

Module V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9 Hours

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

REFERENCES

1. Entrepreneurship fundamentals by Zobias Kollmann International journal of Zechnology management,2007

P18OEBM009	REHABILITATION ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in artificial organs (B.Tech/B.E)				
	Course Coordinator Name & Department:- Ms.Geetha S & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- To develop an understanding of the various rehabilitation aid principle and its working.
- To give various information about rehabilitation medicine and Advocacy.

COURSE OUTCOMES (COs)

CO1		Design rehabilitation aid and apply them with confidence, to help the challenged people.
CO2		The rehabilitation process for people with disabilities often entails the design of assistive devices such as walking aids intended to promote inclusion of their users into the mainstream of society, commerce, and recreation.
CO3		Within the National Health Service of the United Kingdom Rehabilitation Engineers(REs) are commonly involved
CO4		This includes electrically powered wheelchairs, active user (lightweight) manual wheelchairs, and in more advanced clinics this may include assessments for specialist wheelchair control systems and/or bespoke seating solutions.
CO5		Learn about the technologies relating Rehabilitation Engineering
CO6		To Understand the concepts of Rehabilitation in 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	3	3	2			3			2				3	
	CO2				3			3			2	3			
	CO3		2			2	3			2					
	CO4			2				3							
	CO5				3				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)
								✓		

4	Approval	47th Meeting of Academic Council, Aug 2018

UNIT I REHABILITATION TECHNOLOGY 9

Selection, design or manufacturing of augmentive or assistive devices appropriate for individual with disability

UNIT II REHABILITATION SCIENCE 9

Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

UNIT III REHABILITATION ADVOCACY 9

Legal aspect helps the handicapped people in choosing the device, the provisions available to them in this regard.

UNIT IV REHABILITATION MEDICINE 9

Physiological aspects of functional recovery, neurological and psychological aspects, rehabilitation therapies, training to restore vision auditory and speech

UNIT V RÉHABILITATION ENGINEERING TECHNOLOGIES: PRINCIPLESOF APPLICATION 9

Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

REFERENCES

1. Reswick.J. What is Rehabilitation Engineering? ,Annual Review of rehabilitation Volume 2 Springer - Vorlage, New York, 1982.
2. Robinson.C.J, Rehabilitation Engineering, Handbook of electrical engineering, CRC Press, Bocaraton, 1993

P18OEBM010	**BIO MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite course – Knowledge in tissue engineering (B.Tech/B.E)				
	Course Coordinator Name & Department:- Ms.Vinodhini R & Department. of Biomedical Engineering				

COURSE OBJECTIVES:-

- Introduction to bio-mechanics.
- To know mechanical properties of soft biological tissues.

COURSE OUTCOMES (COs)

CO1	To learn Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shearrate, viscosity, visco elasticity and non Newtonian viscosity**.**
CO2	Learn the Flow properties of blood, effect of shear rate.
CO3	To learn Orthopedic biomechanics.
CO4	To learn Skeletal muscles servo mechanism.
CO5	Study the Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury.
CO6	To understand the mechanical activity of biological 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	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
2	CO1	2	1	3	1	2	2	2	2						3
	CO2	2	1	3	1	2	2	2	2						
	CO3	2	1	3	1	2	2	2	2						
	CO4	2	1	3	1	2	2	2	2						
	CO5	2	1	3	1	2	2	2	2						
	CO6	2	1	3	1	2	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)
								✓		

4	Approval		47th Meeting of Academic Council, Aug 2018

UNIT I INTRODUCTION 9

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, mechanical properties of soft biological tissues.

UNIT II MECHANICS OF CIRCULATION 9

Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III MECHANICS APPLIED TO ORTHOPAEDICS 9

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, analysis of force in orthopedic implants.

UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS 9

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION **9**

Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

REFERENCES

1. Y.C.Fung, Biomechanics : Mechanical properties in living tissues, Springer Verlag, Newyork1981.
2. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
3. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.
   Susan J.Hall , Basics Bio Mechanics 4th Edition, McGrawHill Publishing Co,2002.

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.TECH – ENVIRONMENTAL ENGINEERING
(FULL TIME) I – IV SEMESTERS

SEMESTER – I							
S.No	**Category**	**Code**	**Subject Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCER101	Environmental chemistry & Microbiology	3	0	0	3
2	PC	P18PCER102	Air Pollution	3	0	0	3
3	PE		Professional Elective –I	3	0	0	3
4	PE		Professional Elective -II	3	0	0	3
5	PR	P18PRER101	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCER1L1	Environmental Microbiology Lab	0	0	2	2
7	PC	P18PCER1L2	Environmental Chemistry Lab	0	0	2	2
AUDIT COURSE							
8	AC		Audit Course - 1	2	0	0	0
			Total	16	0	4	18

SEMESTER – II

S.No	**Category**	**Code**	**Subject Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCER201	Unit Operations and Unit Processes in Environmental Technology	3	0	0	3
2	PC	P18PCER202	Solid & Hazardous Waste Management	3	0	0	3
3	PE		Professional Elective –III	3	0	0	3
4	PE		Professional Elective – IV	3	0	0	3
PRACTICAL							
5	PC	P18PCER2L1	Unit operations and Unit processes lab	0	0	2	2
6	PC	P18PCER2L2	Advanced Computer Applications Lab	0	0	2	2
7	PR	P18PRER201	Mini Project	0	0	4	2
AUDIT COURSE							
8	AC		Audit course – 2	2	0	0	0
			Total	14	0	8	18

SEMESTER – III

S.No	**Category**	**Code**	**Subject Name**	**L**	**T**	**P**	**C**
1	PE		Professional Elective – V	3	0	0	3
2	OE		Open Elective	3	0	0	3
3	PR	P18PRER301	Dissertation Phase – I	0	0	20	10
			Total	6	0	20	16

SEMESTER – IV

S.No	**Category**	**Code**	**Subject Name**	**L**	**T**	**P**	**C**
1	PR	P18PRER401	Dissertation Phase – II	0	0	32	16
			Total	0	0	32	16

Total Credits for the Programme = 18 + 18 + 16+ 16 =68

LIST OF PROFESSIONAL ELECTIVES

Professional elective (PE I)

S.No.	Code	Subject Name	L	T	P	C
1	P18PEER011	Water and sewage conveyance	3	0	0	3
2	P18PEER012	Instrumental Monitoring of Environment	3	0	0	3
3	P18PEER013	Ecological Engineering	3	0	0	3
4	P18PEER014	Rural Water Supply	3	0	0	3

Professional elective (PE II)

S.No.	Code	Subject Name	L	T	P	C
1	P18PEER021	Statistics for environmental engineers	3	0	0	3
2	P18PEER022	Indoor Air Quality	3	0	0	3
3	P18PEER023	Environmental Impact Assessment	3	0	0	3
4	P18PEER024	Ground water contamination and transport modeling	3	0	0	3

Professional elective (PE III)

S.No.	Code	Subject Name	L	T	P	C
1	P18PEER031	Industrial Wastewater Management	3	0	0	3
2	P18PEER032	Environmental Bio Technology	3	0	0	3
3	P18PEER033	Membrane Separation for Water and Wastewater Treatment	3	0	0	3
4	P18PEER034	Biological treatment of waste water	3	0	0	3

Professional elective (PE IV)

S.No.	Code	Subject Name	L	T	P	C
1	P18PEER041	Mass Transfer in Air – Water Soil Interaction	3	0	0	3
2	P18PEER042	Landfill Engineering and Remediation Technology	3	0	0	3
3	P18PEER043	Principles of Environmental Science	3	0	0	3
4	P18PEER044	Environment, Health and Safety in Industries	3	0	0	3

Professional elective (PE V)

S.No.	Code	Subject Name	L	T	P	C
1	P18PEER051	Marine Pollution Monitoring	3	0	0	3
2	P18PEER052	Remote Sensing and GIS for Environmental Applications	3	0	0	3
3	P18PEER053	Environmental policies and Legislation	3	0	0	3
4	P18PEER054	Advanced Oxidation Process	3	0	0	3

List of Open Electives (OE)

S.No	Code No.	Course Title	L	T	P	C
1	P18OECS001	Business Analytics	3	0	0	3
2	P18OEMA002	Operational Research	3	0	0	3
3	P18OEME003	Industrial Safety	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	0	0	3
5	P18OEME005	Composite Materials	3	0	0	3
6	P18OEEE006	Waste to Energy	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	3	0	0	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

	Sub Area	Credit as per Semester				No. of Credits	% of credit
		I	II	III	IV		
1	Professional Mathematics(PM)	3		-	-	3	4.4
2	Professional Core (PC)	6	6	-	-	12	17.6
3	Professional Electives (PE)	3	6	3	-	12	17.6
5	Open Electives (OE)	2	-	3	-	5	7.4
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)	4	6	10	16	36	53
	Total Credits	18	18	16	16	68	100
	Total Contact Hours	20	22	26	32	100 Hrs	

SYLLABUS
SEMESTER I

P18PCER101	**ENVIRONMENTAL CHEMISTRY&MICROBIOLOG**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental studies				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: -

To educate the students in the area of water air and soil chemistry and train them in the laboratory in the determination of pollutants present in air,water, wastewater and soil.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of chemistry, mainly green Chemis and chromatographic principles	U
CO2	To know the basics of degradation principles, mainly degradation of pesticides, food stuffs etc.	R
CO3	To understand about the basics of aquatic chemistry and redox reactions.	U
CO4	To improve the knowledge on the fundamentals of atmospheric Chemistry and various regions of atmosphere	U
CO5	To know about the soil chemistry, salt and ion exchange theory	Ap
CO6	To understand about the Biodegradation of toxic pollutants	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	PSO1	PSO2	PSO3
2	CO1	1	2		3		2	1	1
	CO2	1			2	3	1	1	2
	CO3		3	1	2		1	1	1
	CO4		3	1	2			2	1
	CO5	2	3		2		1	1	2
	CO6		2			1		3	2

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I FUNDAMENTALS **9**

Colloids – Redox Potentials – Partition Co-Efficient – Beer – Lambert's Law – Limitations UV Visible Spectroscopy – Basic Principle – Application – Atomic Absorption Spectroscopy – Principles- Applications Gas Chromatograph Principles And Applications – Principles Of Green Chemistry - Error Analysis of Environmental Data.

UNIT-II AQUATIC CHEMISTRY **9**

Transport and Transformation of Chemicals – DO, BOD and COD – Photo Catalysis – Metals, Complex Formation, Oxidation and Reduction And Sorption – Eh – pH Diagrams- Chemical Speciation – QSAR – Risk Evaluation Of Chemicals.

UNIT-III ATMOSPHERIC &SOIL CHEMISTRY **9**

Regions Of Atmosphere- Chemical And Photochemical Reactions – Photochemical Smog , Ozone Layer Depletion – Green House Gases And Global Warming – Acid Rain - Soil Properties Clay Minerals – Acid – Base and Ion Exchange Reactions In Soil – Salt affected Soil And Its Remediation

UNIT-IV MICROBIOLOGY OF ENVIRONMENT **9**

Classification of microorganisms- prokaryotic, eukaryotic,Distribution of microorganisms - Water ,air and Soil, indicator organisms ,Coli forms –Fecal coliforms, E. coli, Streptococcus, Clostridium, Significance in water Algae in water supplies – problems and control, Concentration and detection of Virus, Transmissible diseases.

UNIT-VROLE OF MICROORGANISMS IN WASTEWATER TREATMENT **9**

Microbiology of biological treatment processes-aerobic and anaerobic, Biodegradation of toxic pollutants-mechanisum-- α-oxidation, β-oxidation, nitrification and denitrification, eutrophication.

REFERENCES:

1. C.N. Sawyer, P.L. MacCarty and G.F. Parkin , Chemistry for Enviromental Engineering and Science , Tata MeGraw – Hill, fifth edition, New Delhi, 2003.
2. De.A.K. "Environmental Chemistry", New age International Ltd., New Delhi, 2001.

3. G.W. Vanloon and S.J. Duffy "Environmental Chemistry - a global perspective oxford university press, New York ,2000.
4. D.W. Connell, Basic concepts of Environmental Chemistry , Lewis publishers, New York, 1997.
5. Bhatia S.C. , "Hand Book of Environmental Microbiology", Part 1 and 2, Atlantic Publisher 2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition
6. SVS. Rana, "Essentials of Ecology and Environmental Science", 3rd Edition, Prentice Hall of India Private Limited
7. Maier, R.M., I.L. Pepper and C.P. Gerba, "Environmental Microbiology", Academic Press, New York, 1999.
8. Tortora G.J, B.R. Furke, and C.L. Case, "Microbiology-An Introduction" (4th Ed.),.BENJAMIN /Cummings Pulb. Co.,Inc., California,1992.
9. Frank C.Lu and Sam Kacew, LU's Basic Toxicology,Taylor& Francis, London(4th Ed), 2002.
10. Baker .K.H.andD.S.Herson .Bioremediation, McGraw – Hill Inc., Newyork, 1999.

Course coordinator **HOD**

P18PCER102	**AIR POLLUTION**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Studies				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on various methods of control of particulate and gaseous air pollutants.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of air quality management classification of microorganisms,its culturing modes.	U
CO2	To understand about the methods of particulate control like gravitational and centrifugal filters	Ap
CO3	To understand in detail about the phenomenon of adsorption and absorption thus explaining more on control of gaseous air contaminants.	Ap
CO4	To improve the knowledge on the emerging trends of air pollution control and disc in detail about automobile air pollution	E
CO5	To know about the basics of the standards of noise pollution and methods to preven pollution	R
CO6	To know about the Biological Air Pollution Control 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	PSO1	PSO2	PSO3
2	CO1	1	3		2		3	1	1
	CO2	3		2		1	3	2	1
	CO3	3		1	2		2	1	2
	CO4	1			3	2	3	3	2
	CO5	3		1	2		3	2	1
	CO6	2		2	1	2	1	2	2

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION **9**

Air resource management system – Air quality management – Scales of air pollution problem – Sources and classification of pollutants and their effect on human health vegetation and property - Global implications of air pollution – Meteorology Fundamentals – Atmospheric stability – Micrometeorology – Atmospheric turbulence-mechanical and thermal turbulence – wind profiles – Atmospheric Diffusion – Atmospheric diffusion theories – Steady-state atmospheric diffusion equation – Plume rise – Diffusion models – Software applications – Ambient air quality and emission standards – Air pollutions indices – Indoor Air Pollutants – models – Air Quality Sampling and Monitoring.

UNIT-II CONTROL OF PARTICULATE CONTAMINANTS **9**

Settling chambers – Filters, gravitational, Centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory – ESP design – Operational Considerations – Process Control and Monitoring – Case Studies.

UNIT-III CONTROL OF GASEOUS CONTAMINANTS **9**

Absorption – principles – description of equipment-packed and plate columns – design and performance equations – Adsorption – principal adsorbents – Equipment descriptions – Design and performance equations – Condensation – design and performance equation – Incineration – Equipment description – design and performance equations – Biological Air

Pollution Control Technologies – Bio-Scrubbers, Biofilters – Operational Considerations – Process Control and Monitoring-Case Studies.

UNIT-IV EMERGING TRENDS **9**

Process Modification – Automobile Air Pollution and its control – Fuel Modification – Mechanical Particulate Collectors – Entrainment Separation - Internal Combustion Engines – Membrane Process – Ultraviolet Photolysis – High efficiency Particulate Air Filters – Technical & Economic Feasibility of selected emerging technologies for Air pollution control – Control of Indoor Air Quality – Radio active pollution and its control.

UNIT-V NOISE CONTROL **9**

Noise Standards – Measurement – Modeling – Control and preventive measures.

REFERENCES:

1. Anjaneyulu. Y, "Air Pollution & Control Technologies" Allied Publishers (P) Ltd.,India, 2002.
2. M.N. Rao et al, "Air Pollution", Tata McGraw Hill, 2009.
3. LawrenceK.Wang, Norman C Perelra, Yung- Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
4. Noel de Nevers, Air Pollution Control Engg.,McGraw-Hill, New York, 1995.
5. David H.F Liu, BelaG.Liptak "Air Pollution", Lewis Publishers, 2000.

Course coordinator **HOD**

P18PRER101	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	**2**	**0**	**0**	**2**
	Prerequisite course: Project Management Study				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To introduce the students to the principles and practice of research methodology.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the procedure for preparing literature.	U
CO2	To understanding the process of approaching a research topic.	An
CO3	To understand and analyze the concepts of a given research topic.	An
CO4	To understand the students responsibilities in a research work.	R
CO5	To understand the methodology for preparing a research paper.	Ap
CO6	To understand the need for research developments.	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	PSO1	PSO2	PSO3
2	CO1	3		2		1	1	1	1
	CO2	3				1		2	1
	CO3	3						2	
	CO4	3		2			1	2	2
	CO5	3					1	2	1
	CO6	3		2		2	1	2	3
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	OpenElective (OE)			**Project/Term Paper/ Seminar/ Internship(PR)**	
4	Approval	Meeting of Academic Council, May 2018							

UNIT I RESEARCH CONCEPTS 9

Meaning of research problem, Sources of research problem, Criteria Characteristicsof a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT IIRESEARCH ETHICS 9

Effective literature studies approaches, analysis plagiarism, Research ethics,Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT III RESEARCH INNOVATION 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV RESEARCH TECHNOLOGY 9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patentinformation and databases. Geographical Indications.

UNITV RESEARCH DEVELOPMENTS **9**

New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXTBOOK:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.

REFERENCES:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007. Mayall , "Industrial Design", McGraw Hill, 1992.
2. Niebel , "Product Design", McGraw Hill, 1974.
3. Asimov, "Introduction to Design", Prentice Hall, 1962.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Course coordinator **HOD**

P18PCER1L1	**ENVIRONMENTAL MICROBIOLOGY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours:30	**0**	**0**	**2**	**2**
	Prerequisite course: Environmental Engineering-I				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To train the students in the analysis of various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To know about the basic water sample analysis techniques used in water as well as Wastewater testing.	P
CO2	To know the sampling of micro organisms.	M
CO3	Having a deep knowledge about factors influencing bacterial Growth	P

CO4	With a true wisdom about serial dilution techniques and methods to prepare pure cult	GR
CO5	Having a sound knowledge in the bacteriological analysis of waste water.	M
CO6	To know about the importance of various microbial processes in wastewater treatment	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	PSO1	PSO2	PSO3
2	CO1			1	2	3	2	1	1
	CO2		2	1		3	1	2	2
	CO3		3		2	1	2	1	2
	CO4		2	1	3		1	1	1
	CO5		1		3	2		2	2
	CO6		1		2	2	1	1	2

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS

1. Preparation of media, serial dilution and plating, Growth curve .
2. Sampling of Microorganisms from air, water and soil, staining-simpleand gram staining.
3. Effect of pH, temperatures and nutrients on growth of bacteria.
4. Bacteriological analysis of water – Coli forms and streptococcus fecalis by MPN and membrane filter technique.
5. Study of aquatic organisms – Algae, Protozoa and fungi.

REFERENCES:

1. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington,
2012.

2. Charles P. Gerba, "Environmental Microbiology: A laboratory manual", Elsevier Publications, 2012.
3. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D.
Stetzenbach, "Manual of Environmental Microbiology", 3rd Edition, ASM Press, 2007.

Course coordinator **HOD**

P18PCER1L2	**ENVIRONMENTAL CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours:30	**0**	**0**	**2**	**2**
	Prerequisite course: Environmental Engineering-I				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To train in the analysis of physico-chemical parameters with hands on experience.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To know about the basic water sample analysis techniques.	P
CO2	To know about the basic wastewater sample analysis techniques.	P
CO3	To know the procedure of analyzing the organic pollutants present in the wastewater.	S
CO4	With a true wisdom about serial dilution techniques and methods to prepare pu culture.	GR
CO5	Having a deep knowledge about soil analysis techniques.	M
CO6	To know about the air pollutant sampling techniques.	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	PSO1	PSO2	PSO3
2	CO1			1	2	3	3	1	1
	CO2		2	1		3	3	1	1
	CO3		3		2	1	2	1	2
	CO4		2	1	3		2	2	1

	CO5		1		3	2	3	2	2
	CO6		1		2		1		3
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)			
4	Approval	Meeting of Academic Council, May 2018							

List of Experiments

1. **Physical and Chemical Analysis of Water**
   pH, Conductivity, Turbidity, Solids, Chlorides, Sulphates, Alkalinity, Fluorides, Nitrate and heavy metals.
2. **Physical and Chemical Analysis of Wastewater**
   Phosphate, COD, BOD, Organic and ammonical nitrogen, Oil & grease.
3. **Air Quality Analysis**
   SPM, SO_2, CO, NO_X.
4. **Soil Analysis**
   pH, Conductivity, Cation exchange capacity, Sodium Absorption ratio.

REFERENCES:

1. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington, 2012.
2. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 3rd Edition, 1999.
3. "Methods of air sampling & analysis", JamesP.LodgeJr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

Course coordinator **HOD**

SEMESTER II

P18PCER201	**UNIT OPERATIONS AND UNIT PROCESSES IN ENVIRONMENTAL TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-I,II				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To conduct laboratory studies on water and wastewater treatment units.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To Know about selection of unit operations and unit processes.	An
CO2	To Know the principles of sedimentation and flotation processes .	U
CO3	Having a deep knowledge about the filtration processes and filter media.	R
CO4	To understand chemical unit processes and disinfection methods.	R
CO5	Having a sound knowledge in the biological treatment process .	U
CO6	To understand the Kinetics of Biological growth	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	PSO1	PSO2	PSO3
2	CO1		2			3	2	3	1
	CO2		2	1	2	2	2	3	1
	CO3	2	3	1	1	2	2	3	1
	CO4		2	1		3	2	3	1
	CO5	1	2		3	1	2	3	1
	CO6	1		3		2	2	3	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I FUNDAMENTAL PHYSICAL UNIT OPERATIONS 9

Factors in selection of unit operations and processes – Principal type of Reactors – Flow measurement – Screening – Flow Equalisation – Mixing – static and Mechanical mixers – Coagulation and Flocculation – Perikinetic and Orthokinetic flocculation.

UNIT-II PRINCIPLES OF SEDIMENTATION AND FLOTATION 9

Sedimentation – Type of setlting – Removal ratio – Clarifier-thickener- Floatation - Dissolved air flotation.

UNIT-III FILTRATION 9

Filtration – classification of filters-Head loss through filters– Darcy equation.

UNIT-IV CHEMICAL UNIT PROCESSES 9

Chemical precipitation – phosphate removal – Adsorption – Activated carbon – Isotherms – Disinfection – principles – types of chlorination – Dechlorination.

UNIT-V BIOLOGICALUNIT PROCESSES 9

Kinetics of Biological growth - Suspended and attached growth processes - Aerobic and Anaerobic - Determination of kinetic co-efficients.

REFERENCES:

1. Metcalf& Eddy, Inc. 'Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi 2003.
2. Lee, CC & Shun dar Lin, Hand book of Environmental Engineering Calculations, McGraw Hill, New York,1999.
3. Casey T.J. Unit treatment processes in water and wastewater engineering, John Willeys Sons, London, 1993.

Course coordinator **HOD**

P18PCER202	**SOLID AND HAZARDOUS WASTE MANAGEME**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	**3**	**0**	**0**	**3**
	Prerequisite course Environmental Health Engineering				

	Course Coordinator Name & Department: Civil Engineering

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 disposal.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of solid and hazardous wastes and als the types, need and sources of solid and hazardous wastes.	R
CO2	To understand about the methods of waste characterisation and source reduction a to study the various methods of generation of wastes.	U
CO3	To understand in detail about the storage, collection and transport of wastes and al to study about the methods used for handling and segregation of wastes.	U
CO4	To improve the knowledge on the waste processing techniques which includesincineration solidification and stabilization of hazardous wastes	U
CO5	To know about the basics of the waste disposal options and also a detailed study on the disposal in landfills and also to learn about landfill remediation.	Ap
CO6	To improve the knowledge on techniques to manage industry specific solid waste issues.	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	PSO1	PSO2	PSO3
2	CO1		3		2	1	1	2	1
	CO2		2		1	3	2	1	2
	CO3		3		1	2	1	2	2
	CO4		2		1	3	2	3	3
	CO5		1		2	3	1	3	3
	CO6		2		1	2	2	3	3

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
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-IIWASTE CHARACTERISATION 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- compactability, 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.

REFERENCES:

1. Solid and Hazardous waste management, M.N.Rao and Razia sultana,October 2016,First Edition,Elsevier.

2. Solid and Hazardous waste management,S.C.Batia,Atlantisc Publishers,2007

3. CPHEEO "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
4.GeorgeTchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw- Hill International edition, New York, 1993.
5.Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, McGraw- Hill International edition, New york, 2001.
6.Vesilind P.A., Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.

Course coordinator **HOD**

P18PCER2L1	**UNIT OPERATIONS AND UNIT PROCESSES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours:30	**0**	**0**	**2**	**2**
	Prerequisite course: Environmental Engineering-I,II				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To conduct laboratory studies on water and wastewater treatment units.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To Know about selection of unit operations and unit processes.	GR
CO2	To Know the principles of sedimentation and flotation processes.	P
CO3	Having a deep knowledge about the filtration processes and filter media.	P
CO4	To understand chemical unit processes and disinfection methods.	M
CO5	Having a sound knowledge in the biological treatment process.	M
CO6	To understand the principles of pretreatment of waste water.	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	PSO1	PSO2	PSO3
2	CO1			1	2	3	3	1	1
	CO2		2	1		3	2	1	1
	CO3		3		2	1	2	2	
	CO4		2	1	3		2	1	1

	CO5		1		2	3	2	1	1
	CO6		1		3	2	2	2	1
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)			
4	Approval	Meeting of Academic Council, May 2018							

LIST OF EXPERIMENTS

1. Coagulation and Flocculation.
2. Batch Studies for Sedimentation.
3. Characteristics of Filter media.
4. Studies on Filtration.
5. Water softening.
6. Adsorption studies/ Kinetics.
7. Silt Density Index.
8. Reverse Osmosis.
9. Kinetics of suspended growth process (activated sludge process).
10. Kinetics of attached growth process (Rotating Biological Contractors).
11. Sludge volume Index.
12. Anaerobic Reactor Systems/ Kinetics.
13. Advanced Oxidation Processes.
14. Chlorine Demand Estimation.

REFERENCES:

1.Metcalf & Eddy, Inc. 'Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi 2003.

2.Lee, CC & Shun dar Lin, Hand book of Environmental Engineering Calculations, Mc Graw Hill, New York,1999.

3.Casey T.J. Unit treatment processes in water and wastewater engineering, John Willeys Sons, London, 1993.

Course coordinator **HOD**

P18PCER2L2	**ADVANCED COMPUTER APPLICATIONS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**

	Prerequisite course: Environmental Engineering-II
	Course Coordinator Name & Department: Civil Engineering

COURSE OBJECTIVES:-

To design wastewater treatment units.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To Know about selection of unit operations and unit processes.	GR
CO2	To Know the principles of wastewater treatment processes .	P
CO3	Having a deep knowledge about the filtration processes and filter media.	P
CO4	To understand wind and temperature profile.	GR
CO5	Having a sound knowledge in the biological treatment process .	M
CO6	To Know the techniques of air pollution monitoring.	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	PSO1	PSO2	PSO3
2	CO1			1	2	3	2	2	1
	CO2		2	1		3	1	1	1
	CO3		3		2	1	1	2	1
	CO4		2	1	3		1	1	1
	CO5		1		3	2	1	2	1
	CO6		1		2	2	2	2	3

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS

1. Design of Septic Tank
2. Design of Trickling Filter
3. Calculation of Pollutant Concentration

4. Wind profile
5. Temperature Profile
6. Design of Activated Sludge Process
7. Design of Waste Stabilization Lagoon
8. Design of Rotating Biological Contactor
9. Design of Oxidation Ditch
10. Design of Oxidation Pond

REFERENCES:

1. Metcalf & Eddy, Inc. 'Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi 2003.
2. Programming in ANSI C 6th Edition by E. Balaguruswamy.
3. Manual on Sewerage and Sewage Treatment (CPHEEO),Ministry of Urban Development, Government of India, New Delhi, 1993.
4. H.S.Peavy, D.R. Rowe and George Tchobanoglous, Environmental Engineering Mo Graw Hill Company, New Delhi, 1995.
5. Shah C.S., Water Supply and Sanitation, Galgotia Publishing Company, New Delhi, 1998.

Course coordinator **HOD**

P18PRER201	**MINI PROJECT**	**L**	**T**	**P**	**C**
	Total Contact Hours/ Week: 4	**0**	**0**	**4**	**2**
	Prerequisite course: B.E/B.Tech In Civil Engineering				
	Course Coordinator Name & Department: 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	Identify environmental engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex environmental systems.	M
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	A
CO4	To do practical or case study experiments based on his /her projects.	M
CO5	To submit the project in a full form report	M
CO6	To have problem solving ability for solving environmental engineering problems	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	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	1	1	2
	CO2	2	2		2	1	2	3	2
	CO3	2	3		1	2	2	3	3
	CO4		3	2	2	1	2	3	2
	CO5		2	1	1	3	2	2	1
	CO6		1	2	2	3	1	3	3
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	OpenElective (OE)	**Project/Term Paper/ Seminar/ Internship(PR)**			
4	Approval	Meeting of Academic Council, May 2018							

Syllabus Contents:

Mini Project will have mid semester presentation 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 Semester and End Semester will be monitored by the departmental committee.

Course coordinator **HOD**

SEMESTER III

P18PRER301	**DISSERTATION STAGE I**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 20	**0**	**0**	**20**	**10**
	Prerequisite course: Mini Project				
	Course Coordinator Name & Department: 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	Identify environmental engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex environmental systems.	M
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	A
CO4	To do practical or case study experiments based on his /her projects.	M
CO5	To submit the project in a full form report	M
CO6	To have problem solving ability for solving environmental engineering problems	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	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	1	1	2
	CO2	2	2		2	1	2	3	2
	CO3	2	3		1	2	2	3	3
	CO4		3	2	2	1	2	3	2
	CO5		2	1	1	3	2	2	1
	CO6		3	1	2	2	1	3	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	OpenElective (OE)	**Project/Term Paper/ Seminar/ Internship(PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation-I will have mid semester presentation 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 and must bring out individualscontribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Semester and End Semester will be monitored by the departmental committee.

Course coordinator **HOD**

SEMESTER IV

P18PRER401	**DISSERTATION STAGE II**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 20	**0**	**0**	**32**	**16**
	Prerequisite course: Dissertation Stage I				
	Course Coordinator Name & Department: 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	Identify environmental engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex environmental systems.	M
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	A
CO4	To do practical or case study experiments based on his /her projects.	M
CO5	To submit the project in a full form report	M
CO6	To have problem solving ability for solving environmental engineering problems	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	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	1	1	2
	CO2	2	2		2	1	2	3	2
	CO3	2	3		1	2	2	3	3
	CO4		3	2	2	1	2	3	2
	CO5		2	1	1	3	2	2	1
	CO6		3	1	2	2	1	3	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	OpenElective (OE)	**Project/Term Paper/ Seminar/ Internship(PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc.There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Course coordinator **HOD**

LIST OF PROFESSIONAL ELECTIVES

Professional Elective (PE - I)

P18PEER011	**WATER AND SEWAGE CONVEYANCE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-I,II				
	Course Coordinator Name &Department:Civil Engineering				

COURSE OBJECTIVES:-

To educate the students in detailed concepts related to water transmission mains, water distribution system, sewer networks and storm water drain, with emphasis on computer application**s.**

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of hydraulic engineering and the various fluid flow phenomenon	U
CO2	To understand about the methods of water transmission and distribution and the economics related to water transmission	U
CO3	To understand in detail about the waste water collection and conveyance and also the maintenance of sewers and design of sewer outfalls	An
CO4	To improve the knowledge on the planning and estimation of storm water flow	E
CO5	To know about the basics of the Case Studies and Computer applications for water transmission	Ap
CO6	To know about the basics of Computer applications in Sewer Design	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	1	2	1
	CO2	1	3	1	2	2	1	2	1
	CO3		3	1	1	2	1	3	2
	CO4		2	1		3	1	3	2
	CO5	3	2		3	2	1	3	2
	CO6	3	2		3	2	1	3	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I PRINCIPLES OF HYDRAULICS 9

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, major and minor head loss, formula for estimation of head loss – pumping of fluids – selection of pumps – Flow measurement.

UNIT-II WATER TRANSMISSION AND DISTRIBUTION 9

Planning factors – Water transmission main design – pipe material – economics – water hammer analysis; water distribution pipe networks - methods for analysis and optimization - Laying and maintenance, insitu lining – appurtenances – corrosion prevention – minimization of water losses – leak detection.

UNIT-III WASTEWATER COLLECTION AND CONVEYANCE 9

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

UNIT-IV STORM WATER DRAINAGE 9

Planning – run-off estimation, rainfall data analysis, storm water drain design – rain water harvesting

UNIT-V CASE STUDIES AND COMPUTER APPLICATIONS 9

Computer applications for water transmission, water distribution and sewer design.

REFERENCES:

1.G.S.Bajwa, Practical Handbook on Public Health Engineering, Deep Publishers, Shimla, 2003.

Course coordinator HOD

P18PEER012	**INSTRUMENTAL MONITORING OF ENVIRONMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**

	Prerequisite course: Environmental Engineering-I,II
	Course Coordinator Name & Department: Department of Civil Engineering

COURSE OBJECTIVES:- To educate the students on the various instruments used for analysis of air water and soil.	**Revised Bloom's Taxonomy**
COURSE OUTCOMES (COs)	
CO1 To make them understand the fundamentals of various Instrumental methods in monitoring the environment.	U
CO2 To understand about the various Spectroscopic Methods of determining the precision and	U
CO3 accuracy of the instrument.	An
CO4 To understand in detail about the Chromatographic methods of separation and the classification of these methods in detail.	E
CO5 To improve the knowledge on the various Electro and Radio Analytical Methods	Ap
CO6 To understand in detail aboutcontinuous water quality monitoring instruments	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	3	1	
	CO2	2	3	1	2	2	3	1	
	CO3		3	1	1	2	3	1	
	CO4		2	1		3	3	1	
	CO5	3	2		3	1	3	1	1
	CO6		3		2		3	1	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Paper/ Seminar/ InterProject/Term nship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION **9**

Instrumental Methods, Selection of method, Precision and Accuracy, Errors in measuring signals, Noise/signal ratio, base line drift, indicator tubes.

UNIT-II SPECTROSCOPIC METHODS **9**

Electromagnetic radiation, matter radiation interactions; Colorimetry and spectrophotometry, fluorimetry, nephelometry and turbidimetry, flame photometry Atomic Absorption Spectrometry (AAS), Atomic Emission Spectrometry (AES)- Inductively coupled plasma (ICP) and Direct Current Plasma (DCP) Spectrometry. ICP- MS (Mass spectrometry).

UNIT-III CHROMATOGRAPHIC METHODS **9**

Classical methods, Column, Paper and thin layer chromatography (TLC),gas chromatography (GC),GC-MS,High performance liquid chromatography (HPLC) and ion chromatography (IC).

UNIT-IV ELECTRO AND RADIO ANALYTICAL METHODS **9**

Conductometry, potentiometry, coulometry, amperometry polarography, neutron activation analysis (NAA), X-ray fluorescence (XRF) and X-ray diffraction (XRD) methods

UNIT-V CONTINUOUS MONITORING INSTRUMENTS **9**

Non-dispersive infra-red (NDIR)analyzer for CO, Chemiluminescent analyzer for NOx, fluorescent analyzer for SO2,auto analyzer for water quality using flow injection analysis, permeation devices.

REFERENCES:

1. Willard.H. Merritt, L., Dean, D.A.and Settle. F.A. "Instrumental methods of analysis, 7th Edn. Words Worth, New York, 2004.
2. Ewing 'Instrumental Methods of Chemical Analysis, 5th Edn., McGraw-Hill,New York, 1995.

Course coordinator **HOD**

P18PEER013	**ECOLOGICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental studies				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the principles of ecology as applied to environmental engineering.

COURSE OUTCOMES (COs)	**Revised Bloom's Taxonomy**

CO1	To make them understand the introduction to Ecology and Ecological Engineering and its application in all other fields.	U
CO2	To understand about the Principles, components and characteristics of Systems approach in Ecological Engineering	U
CO3	To understand in detail about the Ecological Engineering Processes and determination of sustainable loading of ecosystems	An
CO4	To improve the knowledge on the emerging trends of ecotechnology for waste treatment and also the applications of ecological engineering for marine systems	R
CO5	To know about the case studies of integrated ecological engineering systems and their commercial prospects.	Ap
CO6	To understand about the Principles and operations of Ecosanitation	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	PSO1	PSO2	PSO3
2	CO1	3	2			1	1	1	1
	CO2	1	3	1	2	2	1	1	1
	CO3		3	1	1	2	2	2	2
	CO4		2	1		3	2	3	1
	CO5	3	2		3	1	2	1	
	CO6	2	1	3		2	2	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION TO ECOLOGY AND ECOLOGICAL ENGINEERING 9

Aim, scope and applications of ecology – Development and evolution of ecosystems – principles and concepts pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – productivity in ecosystems – Rationale of ecological engineering and ecotechnology – classification of ecotechnology – principles of ecological engineering

UNIT-II SYSTEMS APPROACH IN ECOLOGICAL ENGINEERING 9

Principles, components and characteristics of systems – Classification of systems – Structural and functional interactions of environmental systems – Environmental systems as energy systems – Mechanisms of steady maintenance in open and closed systems – Modelling and ecotechnology – Elements of modeling – Modelling procedure – Classification of ecological models – Applications of models in ecotechnology – Ecological economics.

UNIT-III ECOLOGICAL ENGINEERING PROCESSES 9

Self – organizing design and processes – Multi seeded microcosms – Interface coupling in ecological systems – Concept of energy – Determination of sustainable loading of ecosystems

UNIT-IV ECOTECHNOLOGY FOR WASTE TREATMENT 9

Ecosanitation – principles and operation of soil in infiltration systems – Wetland and ponds – Source separation systems – Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes – Applications of ecological engineering for marine systems.

UNIT-V CASE STUDIES 9

Case studies of Integrated Ecological Engineering Systems and their commercial prospects

REFERENCES:

1. Ecology and Environmental studies,Santhosh Kumar Garg,Khanna Publishers,2015.
2..Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and practice. Lewis Publishers, New Yark.2003.
3. Etnier, C. and Guterstan, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers, New York,1997.
4.White, I.D., Mottershed, D.N. and Harrison, S.J., Environmental Systems – An Introductory Text, Chapman Hall,Landon.1994.
5.Mitsch, J.W. and Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley & sons, New York. 1989.

Course coordinator **HOD**

P18PEER014	**RURAL WATER SUPPLY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental studies				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the principles of water supply engineering.

COURSE OUTCOMES (COs)	**Revised Bloom's Taxonomy**

CO1	To make them understand the planning of water supply system	U
CO2	To understand about the Principles, components of water treatment	U
CO3	To understand in detail about the distribution of water supply	An
CO4	To improve the knowledge on various rural water supply schemes	E
CO5	To know about the methods of reuse of wastewater	Ap
CO6	To obtain knowledge about the characterization and standards of water quality	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	PSO1	PSO2	PSO3
2	CO1	2	1			1	1	3	1
	CO2	1	3	1	2	2	1	3	1
	CO3		3	1	1	2	1	2	2
	CO4		2	1		3	1	2	1
	CO5	2	2		3	1	2	2	1
	CO6		1		2	3	2	2	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNITIPLANNING OF WATER SUPPLY SYSTEM9

Public water supply system , Planning , Objectives , Design period, Population forecasting Water demand , Sources of water and their characteristics, Surface and Groundwater Impounding Reservoir Well hydraulics, Development and selection of source , Water quality - Characterization and standards- Impact of climate change.

UNITIIWATERTREATMENT 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.

UNITIIIDISTRIBUTIONOF WATER SUPPLY 9

Requirements of water distribution, Components, Service reservoirs, Network design Leak detection, Methods.Water supply -intake structures, Pipes and conduits for water, Pipe materials - Laying, jointing and testing of pipes , Types and capacity of pumps , Selection of pumps and pipe materials.

UNITIVRURAL WATER SUPPLY SCHEMES 9

Ongoing water supply schemes in India (Swajal Schemes, Nitiaayog, National rural drinking water scheme), World Bank plan and action in India, National rural drinking water programme scheme, Technical appraisal of rural water scheme, WHO schemes for small communities and rural areas

UNITVREUSE OF WASTEWATER 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.

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. Metcalf & Eddy, Wastewater Engg. Treatment and Reuse, Tata McGraw Hill, New Delhi (2003).
4. Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York(2000).

F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations CRC

Course coordinator HOD

Professional Elective II (PE - II)

P18PEER021	**STATISTICS FOR ENVIRONMENTAL ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course Numerical Methods				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:-

To Train the students in the analysis of Environmental data using Statistical tools .

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the measures of Central tendency and Dispersion for grouped and ungrouped Data.	U
CO2	To know the basics of estimation theory and Curve fitting by Principles of least squares and Regression lines.	E
CO3	To understand about Sampling distributions	U
CO4	To improve the knowledge on Design of Experiments and Analysis of variance	Ap
CO5	To know about the Statistical Policy Control	R
CO6	To know about the Statistical quality control	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	PSO1	PSO2	PSO3
2	CO1		2			1	1	1	1
	CO2	1	3	1	2	2	1	1	1
	CO3		3	1	1	2	1	1	1
	CO4		2	1		3	1	2	1
	CO5	1	2		3	1	1	1	1
	CO6		3		2	1	1	1	1

13	Category	**Professional Mathematics (PM)**	Professional Core (PC)	Professional Elective (PE)	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I EMPIRICAL STATISTICS **9**

Types of Sampling – Description of Discrete and continuous data – measures of Central tendency and Dispersion for grouped and ungrouped Data – Measures of position- Box and Whisker plot.

UNIT-II ESTIMATION THEORY **9**

Unbiased estimators – Methods of movements – Maximum Likelihood estimation – Curve fitting by Principles of least squares – Regression lines.

UNIT-III TESTING OF HYPOTHESIS **9**

Sampling distributions – Type-I and Type-II errors – Tests based on normal, t, $X^2$and F distributions for testing of mean, Arians and proportions-Test for independence of attributes and goodness of fit.

UNIT-IV DESIGN OF EXPERIMENTS **9**

Analysis of variance – one –way and two way classifications – completely randomized design- Randomized block design – Latin square designs.

UNIT-V STATISTICAL POLICY CONTROL **9**

Statistical quality control – Statistical process control – X and R or S, control chart – Attributes control chart – P-Chart and U-Chart – Control chart Performance.

Total Periods : 45

REFERENCES:

1. Johnson, R. A. and Gupta, C. B., "Miller &Freund"s Probability and Statistics for Engineers", Pearson
Education, Asia, Seventh Edition, 2007.
2. Gupta, S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons,
Eleventh Edition, 2002.
3. Montgomery, D.C and Runger .G.C..," Applied Statistics and probability for Engineers", Wiley
Student Edition.2007.
4. Walpole,R.E.Myers, R.H,Mters,S.L.andye.K."Probability and statistics forengineers and scientists "
Pearson education, Asia ,8th edition,2007.

5. Johnson.R.A.andgupta, C.B.” Miller and Freund’s Probability and statistics for Engineers ,” Pearson
education,Asia,7th edition,2007.
6. Mann.P.S.”Introductory Statistics” John wiley and sons, Inc 5th edition,2004.

Course coordinator **HOD**

P18PEER022	**INDOOR AIR QUALITY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Air &Noise Pollution				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on air pollution and control in the indoor environment.

COURSE OUTCOMES (COs)		**Revised Bloom’s Taxonomy**
CO1	To make them understand the fundamentals of design and operation of buildings for improvements of public health associated with indoor air quality.	U
CO2	To understand about the air pollutants in indoor environments and its characteristics, consequences	U
CO3	To understand in detail about the classification and control of pollutants and case studies associated with it.	R
CO4	To improve the knowledge on the concepts and tools in indoor air quality along with the statistical models associated with it.	E
CO5	To know about the basics of the Indoor air pollution from outdoor sources.	R
CO6	To understand in detail about Measurement methods, Control Technologies of Indoor Air Pollution	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	3	3	3
	CO2		3	1	2	2	3	1	1
	CO3		3	1	1	2	3	1	1
	CO4		2	1		3	3	1	2
	CO5		2		3	1	3	1	1

	CO6	2		3	1		3	1	1
3	Category	Professional Mathematics (PM)		Professional Core (PC)	**Professional Elective (PE)**		OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT-I INTRODUCTION **9**

Indoor activities of inhabitants – residence time.Levels of many pollutants in indoor and outdoor air. Design and operation of buildings for improvements of public health.IAQ policy issues: Sustainability; indoor air quality as a basic human right

UNIT-II INDOOR AIR POLLUTANTS **9**

Air pollutants in indoor environments, private residences, offices, schoolssand public buildings, factors that govern pollutant indoors concentrations, including ventilation. Characteristics, Consequences.

UNIT-III CONTROL OF POLLUTANTS **9**

Control of several pollutant classes, such as radon ,toxic organic gases, combustion byproducts, and microorganisms such as molds and infectious bacteria. Case study by an exploration of public policy related to indoor air.

UNIT-IV CONCEPT AND TOOLS **9**

Concepts and tools: exposure, material-balance models, statistical models ventilation.

UNIT-V INDOOR AIR POLLUTION FROM OUTDOOR SOURCES **9**

Indoor air pollution from outdoor sources: particulate matter and ozone ;Combustion byproducts; Radon and its decay products. Volatile organic compounds: odors and sick-building syndrome, Humidity Bio-aerosols: infectious disease transmission. Special indoor environments: A/C units in indoor: museums -labs; Measurement methods, Control Technologies, Control strategies.

REFERENCES:

1. ThaddesGodish, Indoor air and Environment Quality, CRC press,2000.
2.Nazaroff W.W and L Aivarez-Cohen, Environmental Engineering Science Wiley Sons, New York, 2001.
3.Moroni Marco ,Seifet Bernd and Lindrall Thomas, Indoor Air Quality: A Comprehensive Reference Book, Elsvier Science .Vol.3,1995.

4.Anjaneyulu. Y, “Air Pollution & Control Technologies” Allied Publishers (P) Ltd.,India, 2002.

Course coordinator **HOD**

P18PEER023	**ENVIRONMENTAL IMPACT ASSESSMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-II				
	Course Coordinator Name & Department: Civil Engineering				

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	To make them understand the basics of EIA and its limitations across sectoral issues and terms of references in EIA. It also includes the study of participation of Public and Non-Governmental Organizations in environmental decision making.	U
CO2	To understand about the methods and components of EIA and to learn about the expert systems	U
CO3	To understand in detail about the prediction tools for EIA along with the mathematical modeling for impact prediction.	An
CO4	To improve the knowledge on the ethical and quality aspects of Environmental Impact Assessment.	E
CO5	To know in detail about the Case studies of EIA related to the various sectors in a country like infrastructure, sources of energy etc.	An
CO6	To know preparation, implementation, Mitigation and Rehabilitation Plans in Environmental Management	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	3	2	1
	CO2	1	3	1	2	2	1	3	2
	CO3		3	1	1	2	3	1	2
	CO4		2	1		3	3	1	3

	CO5	1	2		3	1	2	1	3
	CO6		1		3	2	1	1	3
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT-I INTRODUCTION 9

Environment Impact Assessment (EIA) - Environmental Impact statement – EIA in Project Cycle – Legal and Regulatory aspects in India according to Ministry of Environment and Forests – Types and Limitations of EIA- cross sectoral issues and terms of references in EIA- participation of Public and Non-Governmental Organizations in environmental decision making.

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.

UNIT-III PREDICTION, ASSESSMENT OF IMPACTS AND REPORTING 9

Prediction tools for EIA-Mathematical modeling for impact prediction-Assessment of impacts-air-water-soil-noise-biological-socio-cultural environments-Cumulative Impact Assessment-Documentation of EIA findings-planning-organization of information and visual display materials-Report preparation.

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 CASE STUDIES 9

Case studies related to the following sectors-Infrastructure-Mining-industrial-Thermal Power –River valley and Hydroelectric-Nuclear Power.

REFERENCES:

1.Lawrence, D.P., Environmental Impact Assesment - Practical solutions torecurrent problems, Wiley- Interscience, New Jersey, 2003.

2.Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science London,1999.
3.Canter, L.W., Environmental Impact Assessment , McGraw- Hill, New York,1996.
4.Biswas, A.K. and Agarwala, S.B.C. Environmental Impact Assessment for Developing Countries, Butterworth Heinemann, London,1994.
5. The World Bank Group, Environmental Assessment Source Book Vol. I, IIand III. The World Bank, Washington,1991.

Course coordinator **HOD**

P18PEER024	**GROUND WATER CONTAMINATION AND TRANSPORT MODELLING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Studies				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the hydraulics related ground water contamination and modeling ground water quality.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of Ground water and the various hydrologic cycles	U
CO2	To understand about the various steady state hydrologic budgets and various case studies associated with it.	U
CO3	To understand about the evaluation of Ground water Resources.	An
CO4	To improve the knowledge on the basics of Chemical properties and principles.	Ap
CO5	To know about the basics of the Transport process in solute transfer.	U
CO6	To know about the basics hydro chemical behavior of contaminants in the ground water.	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	PSO1	PSO2	PSO3
2	CO1		3			1	1	1	1
	CO2	2	3	1	2	2	1	1	1

	CO3		3	1	1	2	2	1	1
	CO4		2	1		3	3	1	1
	CO5	1	2		3	1	3	1	1
	CO6	3	2				3	1	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT-I INTRODUCTION **9**

Ground water and the hydrologic cycles – Ground water as resources – Ground water contamination –Water quality standards-Sources of contamination-Land disposal of solid wastes – Sewage disposal on Land.Ground water and geologic processes.Physical properties and principles-Darcy's Law- Hydraulic Head and Fluid Potential- Piezometers and Nestes. Hydraulic conductivity and permeability- Homogeneity and Anisotropy – Porosity and voids Ratio- Unsaturated flow and the water table- steady state flow and transient flow – Compressibility and effective stress – Transmissivity and storability – Equations of ground water flow – Limitations of Darcian Approach – Hydro dynamic dispersion – Case Studies.

UNIT-II HYDROLOGIC CYCLE AND FLOW NETS **9**

Flow nets – Graphical construction – Flow nets by numerical simulation. Steady state Regional Ground Water flow – steady state hydrologic budgets – Fluctuations in ground water levels– Case Studies.

UNIT-III RESOURCE EVALUATION **9**

Development of Ground Water resources – Exploration for Aquifers – the response of Ideal acquifers to pumping – Measurement of parameters – Laboratory tests - Piezometer test – Pumping tests – Estimation of saturates Hydraulic conductivity – Numerical simulation for aquifer yield prediction – Artificial recharge and induced infiltration – Land subsidence – Sea water intrusion –Case Studies.

UNIT-IV CHEMICAL PROPERTIES AND PRINCIPLES **9**

Constituents – Chemical equilibrium _ Association and Dissociation of dissolved species – effects of concentration gradients – Mineral dissolution and solubility – Oxidation and reduction process – Ion exchange and Adsorption – Environmental isotopes – Field Measurment of Index parameters- Hydro chemical facies – Ground water in carbonate terrain

– Ground Water in crystalline rocks- ground water in complex sedimentary systems – Geochemical interpretation of ^{14}C Dates – Process rates and molecular diffusion.

UNIT-V SOLUTE TRANSPORT **9**

Transport process – non-reactive constituents in homogeneous media and Heterogeneous media – Transport in Fracture media – Hydro chemical behavior of contaminants- trace metals – Trace nonmetals – Nitrogen, organic substances- Measurement of parameters – Velocity – Dispersivity – chemical partitioning.

REFERENCES:

1. Randall J. Charbeneau, "Ground water Hydraulics and Pollutant transport " PrenticeHall,Upper Saddle.
2. Todd David Keith , Ground water Hydrology, second edition , john Wiley and sons New York, 1980.
3. Allen Freeze, R. and John A. Cherry , "Ground Water ", Prentice Hall, Inc.1979.

Course coordinator **HOD**

Professional Elective III (PE - III)

P18PEER031	**INDUSTRIAL WASTEWATER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Industrial Waste Treatment and Disposal				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on complete management principles related to individual Waste water- starting from wastewater source identification up to reuse concepts

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of uses of water by industry-sources and types of industrial wastewaters	U
CO2	To understand about the methods of prevention vs. control of industrial pollution including the various benefits and barriers	U
CO3	To understand in detail about the Industrial Wastewater Treatment and all the processesin detail.	R
CO4	To improve the knowledge on the emerging trends of wastewater reuse and residual management	E
CO5	To understand the various industrial manufacturing processes	U
CO6	To obtain knowledge about the Industrial wastewater treatment procedures	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	PSO1	PSO2	PSO3
2	CO1			3		2	3	2	2
	CO2		3	1	3	2	3	2	2
	CO3	2	3	1	1	2	2	3	2
	CO4		2	1		3	2	3	3
	CO5	1	2		3	1		3	1
	CO6		3		1		2	3	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION **9**

Industrial scenario in India- Industrial and Environment-Uses of water by industry-Sources and types of industrial wastewater- Industrial wastewater and environmental impacts-regulatory requirements for treatment of industrial wastewater-Industrial waste survey-Industrial Wastewater generation rates, characterization and variables-Population equivalent-Toxicity of Industrial effluents and Bioassay tests.

UNIT-II INDUSTRIAL POLLUTION PREVENTION **9**

Prevention Vs control of Industrial Pollution-Benefits and Barriers-Source reduction techniques-Waste audit-Evaluation of Pollution Prevention options-Environmental statement as a tool for Pollution Prevention-Waste minimization Circles.

UNIT-III INDUSTRIAL WASTEWATER TREATMENT **9**

Equalisation- Neutralisation- Oil separation-Flotation-Precipitation-Heavy metal Removal - Refractory organics separation by adsorption-Aerobic and anaerobic biological treatment-Sequencing batch reactors-High Rate reactors-Chemical Oxidation - Ozonation-Photocatalysis-Wet Air Oxidation-Evaporation-Ion Exchange-Membrane Technologies - Nutrient removal.

UNIT-IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT **9**

Individual and Common Effluent Treatment Plants-Joint treatment of industrial Wastewater-Zero effluent discharge Systems-Quality requirements for Wastewater reuse-Industrial reuse-Disposal on Water and land-Residuals of industrial Wastewater treatment-Quantification and Characteristics of Sludge- Thickening, digestion, conditioning, dewatering and disposal of sludge-Management of RO rejects.

UNIT-V CASE STUDIES **9**

Industrial manufacturing Process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles-Tanneries-pulp and paper-metal finishing-Petroleum Refining-Pharmaceuticals-Sugar and Distilleries-Food Processing-fertilizers-Thermal Power Plants and Industrial Estates.

REFERENCES:

1. Industrial Waste Water Treatment,A.D.Patwardhan,Prentice hall of India private ltd,2008.

2. Eckenfelder,W.W., “Industrial Water Pollution Control”, McGraw-Hill, 1999.
3. Arceivala, S.J., “Wastewater Treatment for Pollution Control”, Tata McGraw-Hill. 1998.
4. Frank Woodard Industrial Waste treatment Handbook,ButterworthHeinemann,New Delhi, 2001.
5. World Bank Group, “Pollution Prevention and Abatment Handbook-Towards Cleaner Production,World Bank and UNEP,Washington D.C.1998.
6. Paul L.Bishop “Pollution Prevention;- Fundamentals and practice”, McGraw-Hill International, 2000

Course coordinator **HOD**

P18PEER032	**ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-I				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the principles and application of biotechnology in environmental engineering with special reference to waste treatment.

COURSE OUTCOMES (COs)		**Revised Bloom’s Taxonomy**
CO1	To make them understand the principles and concepts of environmental biotechnology	U
CO2	To understand about the concept of Environmental biotechnology and its detoxification methods , biotransformation of metals	U
CO3	To understand in detail about the microbial technology for waste treatment and the biotechnological remedies for environmental pollution	R
CO4	To improve the knowledge on the emerging trends of Recombinant DNA Technology and its application in genetic engineering	R
CO5	To know about the environmental effects, patents which includes the safe use of animals in EBT.	U
CO6	To understand in detail about the ethics of microbial technology.	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	PSO1	PSO2	PSO3
2	CO1		2			1	1	1	1
	CO2	1	3	1	2	2	3	1	1
	CO3		3	1	1	2	3	2	
	CO4		2	1		3	1		1
	CO5	1	2		3	1	1	1	1
	CO6	2		1			1	1	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**		OpenElective (OE)		Project/Term Paper/ Seminar/ Internship(PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT-I INTRODUCTION **9**

Principles and concepts of environmental biotechnology – usefulness to mankind, current status.

UNIT-II DETOXIFICATION OF ENVIRONMENTAL POLLUTANTS **9**

Degradation of high concentrated toxic pollutants – halogenated ,non-halogenated petroleum hydrocarbons, metals, mechanisms of detoxification – oxidation, dehalogenation, biotransformation of metals ,biodegradation of solid wastes.

UNIT-III MICROBIAL TECHNOLOGY FOR WASTE TREATMENT **9**

Biotechnological remedies for environmental pollution – decontamination of ground water system, subsurface environment – reclamation concepts – bioremediation. Production of proteins – biofertilizers . Physical, chemical and microbiological factors of composting – health risk – pathogens – odour management –Microbial cell / enzymes technology – adapted microorganisms – biological removal of nutrients – algal biotechnology and application in agriculture – role of extracellular polymers. Biogas Technology-case studies.

UNIT-IVRECOMBINANT DNA TECHNOLOGY AND GENETIC APPLICATION9

Concept of rDNA technology – expression vectors – cloning of DNA –mutation – construction of microbial strains, radioactive probes , protoplast fusion technology-applications.

UNIT-VETHICAL AND REGULATORY ISSUES **9**

Environmental effects and ethics of microbial technology – safety of genetically engineered organisms – microbial containment – Risk assessment, IPR- patents.

REFERENCES:

1. Chaudhury, G.R. "Biological degradation and Bioremediation of toxic chemicals" Dioscorides press, Oregon, 1994.

2. MartinA.M,"Biological degradation of Wastes", Elsevier Applied Science,London, 1991 Blaine Metting .F (Jr.) Soil Microbiology Ecology ,Marcel DekkarInc, 1993.

3. Wainwright M, An Introduction to environmental Biotechnology, 1999.

4 .Old, R.W. and Primrose, S.B. Principles of Gene Manipulation 3rd Ed. Blackwell Sci. Publ., Cambridge, 1985.

Course coordinator **HOD**

P18PEER033	**MEMBRANE SEPARATION FOR WATER AND WASTEWATER TREATMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-I				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the principles and concepts of membrane filtration processes	U
CO2	To understand about the concept of different membrane systems and their Economics	U
CO3	To understand in detail about the membrane bioreactors and the design principles	R
CO4	To improve the knowledge on the pretreatment systems and membrane fouling	R
CO5	To know about the design of membrane based water and wastewater treatment systems.	Ap
CO6	To know about the Case studies on Desalination of brackish water	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	PSO1	PSO2	PSO3
2	CO1	3	2			1	1	2	1
	CO2	1	3	1	2	2	1	2	1
	CO3		3	1	1	2	1	3	1
	CO4		2	1		3	1	3	1
	CO5	1	2		3	1	1	3	1
	CO6		3		2		1	3	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)			Project/Term Paper/ Seminar/ Internship(PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT 1 MEMBRANE FILTRATION PROCESSES 9

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics - Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

UNITII MEMBRANE SYSTEMS 9

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection – Plant operations – Economics of Membrane systems

UNITIII MEMBRANE BIOREACTORS 9

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies

UNITIV PRETREATMENT SYSTEMS 9

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning ,Biofoulant control

UNIT V CASE STUDIES **9**

Case studies on the design of membrane based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

REFERENCES:

1. Membrane Separation Processes Paperback – 2008,Nath and Kaushik .
2. Yamamoto K. and Urase T, "Membrane Technology in Environmental management", special issue, Water Science and technology, Vol.41, IWA Publishing, 2000
3. Jorgen Wagner, "Membrane Filtration handbook, Practical Tips and Hints, 2nd Edition, Revision2, Osmonics Inc., 2001.
4. . Symon Jud, MBR Book – "Principles and application of MBR in water and wastewater treatment", Elservier, 2006.
5. WEF, Membrane Bioreactors, WEF manual of Practice No.36, Water Environment Federation, USA.2012.
6. Anthony Wachinski, Membrane Processes for water reuse, McGraw-Hill, USA, 2013
7. Baker, R.W., "Membrane technology and applications", 2nd., John Wiley 2004
8. Noble, R.D. and Stern, S.A., "Membrane Separations Technology: Principles and Applications", Elservier,Netherlands,1995.

Course coordinator **HOD**

P18PEER034	**BIOLOGICAL TREATMENT OF WATSEWATER**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering-II				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students about biological treatment of wastewater

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the introduction on biological treatment of waste water	U
CO2	To understand about the concept of aerobic treatment of wastewater	U
CO3	To understand in detail about the anaerobic treatment of wastewater	R

CO4	To improve the knowledge on the sludge treatment and disposal	E
CO5	To know about the operations, maintenance, management issues of sewage treatment plants	U
CO6	To analyse the case studies of 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	PSO1	PSO2	PSO3
2	CO1		2			1	1	3	1
	CO2		3	1	2	2	2	3	1
	CO3		3	1	1	2	2	3	1
	CO4	2	2	1		3	2	3	1
	CO5		2		3	1	1	3	1
	CO6	1		2			1	3	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term 1Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION **9**

Objectives of biological treatment – significant – aerobic and anaerobic treatment – kinetics of biological growth-Factor affecting growth – attached and suspended growth-Determination of kinetics coefficient for organics removal – biodegradability assessment-selection of process.

UNIT-II AEROBIC TREATMENT OF WASTEWATER **9**

Sewage treatment plant units – screen chamber, grit chamber with proportional flow weir, sedimentation tank- Trickling filter, Rotating Biological contactor, activated slide process & variations, aerated lagoons waste stabilization ponds –nutrients removal systems- natural treatment systems –disinfected disposal option- reclamation and reuse.

UNIT-III ANAEROBIC TREATMENT OF WASTEWATER **9**

Attached and suspended growth, design of units – UASB, up flow filters fluidized beds-septic tanks and disposal –nutrient removal systems –layouts and hydraulic profile-recent advances.

UNIT-IV SLUDGE TREATMENT AND DISPOSAL 9

Sludge management facilities - sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity)- upgrading existing plants-ultimate residue disposal-recent advances.

UNIT-V OPERATIONS,MAINTENANCE, MANAGEMENT &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.

REFERENCES:

1.Arecivala, S.J., Wastewater treatment for pollution control, TMH, New Delhi 1998.
2.Manual on "Sewerage and sewage treatment" CPHEEO, ministry of Urban development, Gol, New Delhi 1999.
3.Metcalf& Eddy, INC , "wastewater Engineering treatment and Reuse. Third edition Tata McGraw-hill publishing company limited, New Delhi,2003.
4.Qasim S.R. Wastewater Treatment Plant, Planning, Design & Operation Technomic Publications, Newyork,1994.

Course coordinator HOD

Professional Elective IV (PE – IV)

P18PEER041	**MASS TRANSFER IN AIR-WATER-SOIL INTERACTION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental chemistry				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the mechanism of material transfer between environmental components - air, water and soil

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals and occurrences of chemical equilibrium and thermal equilibrium at environmental interfaces	U
CO2	To understand about the mass transfer theories and mass transfer coefficients along with environment fundamentals of heat transfer	U
CO3	To understand in detail about the exchange rates between air and water and also thewater interface of lakes and oceans	R
CO4	To improve the knowledge on the exchange rates between water and the earthern material	E
CO5	To know about the basics of the exchange rates between air and soil.	U
CO6	To study about the turbulence above the air - soil interface	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	PSO1	PSO2	PSO3
2	CO1	1	3			1	2	1	1
	CO2			1	2	2	2	2	1
	CO3		3	1	1	2	2	1	1
	CO4			1		3	2	1	1
	CO5	1	2		3	1	3	1	1
	CO6	2		3			3	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I EQUILIBRIUM AT ENVIRONMENTAL INTERFACE 9

Ideal solutions - air - water equilibrium occurrences - pure gases in contact with water pure liquid in contact with air - partition coefficient for the air - water system. Earthern solid - waste equilibrium occurrences - pure solid and liquid chemicals in contact with water and earthern solids. Earthern solid - air equilibrium occurrences - water - liquid chemical equilibrium occurrences - thermal equilibrium at enviror1mental interfaces.

UNIT-II TRANSPORT MECHANISMS 9

Diffusion and mass transfer - molecular diffusion - eddy diffusion - mass transfer theories - mass transfer coefficients - binary mass transfer coefficients in two phases and two resistance theory of interphase mass transfer turbulence in the environment fundamentals of heat transfer - analogy theories of momentum, heat and mass transfer.

UNIT-III EXCHANGE RATES BETWEEN AIR AND WATER 9

Desorption of gases and liquids from aerated basins and rivers - completely mixed basin - plug flow basin - gas exchange rates between the atmosphere and the surface of rivers - exchange of chemical across the air - water interface of lakes and oceans.

UNIT IV EXCHANGE RATES BETWEEN WATER AND THE EARTHERN MATERIAL9

Dissolution of chemicals on the bottom of flowing streams - geometric forms - stream bottom mass transfer coefficients - natural convection dissolution - the upsurge of chemicals from the sediment - water interface of lakes - a Fikian analysis - allnual upsurge rate at sediment - water interface - mass transfer coefficients at the sediment water interface. Flux of chemicals .between sediment and the overlying seawater movement of chemicals through the benthic boundary layer.

UNIT-V EXCHANGE RATES BETWEEN AIR AND SOIL 9

Turbulence above the air - soil interface - the Richardson number - chemical flux rates through the lower layer of the atmosphere - Thronthwaite - Holzman equation evaporation of liquid chemicals spilled on land - chemical flux rates through the upper layer of earthern material.

REFERENCES:

1.Thibodeaux, L.J, "Environmental Chemo dynamics: Movement Of Chemicals In Air, Water and Soil", edition 2., Wiley - Interscience, New York, 1996.

2.Cusssler, E.L, "Diffusion: Mass Transfer in Fluid Systems, "Cambridge University press, 1994.

Course coordinator **HOD**

P18PEER042	**LANDFILL ENGINEERING AND REMEDIATION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering I,II				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To understand the important characteristics and design principles of the waste containment and remediation industry as well as know the relevant regulations and engineering design requirements of landfills and contaminated site remediation

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand about the fundamentals of landfill basics and the Legal framework for landfilling	U
CO2	To understand about the landfill liners and the cover systems and their design	U
CO3	To understand in detail about leachate and landfill gas generation, Design of Landfillgas collection and removal systems	R
CO4	To improve the knowledge on Landfill Construction and Operational Controls	E
CO5	To know about the contaminated site remediation,Audits of landfill environmental performance and management	U
CO6	To understand about Geotechnical Aspects of In Situ Remediation Technology	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	1	3	1
	CO2	1	3	1	2	2	2	3	1

	CO3		3	1	1	2	3	3	1
	CO4		2	1		3	3	3	2
	CO5	1	2		3	1	2	3	3
	CO6	2	1		3		1	3	3
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I LANDFILL BASICS **9**

Waste management Hierarchy- Need for landfills –Environmental Protection by Landfills- Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal framework for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design –- Landfill Design Tasks

UNIT II LANDFILL LINERS AND COVER SYSTEMS **9**

Landfill barrier system components – Design of Compacted clay liners: Factors affecting hydraulic conductivity , Water content-density criteria, Thickness, Desiccation - Geo synthetic Clay Liners and Geomembranes; types, manufacturing, handling, seaming and testing - Asphalt Barriers and Capillary barrier - Composite Liner system design- liner construction and quality control- Leakage through Liners- vapor transmission and chemical compatibility - Installation of Geo membranes - Liner Leakage Mechanism – Diffusion - Controls on advection through liners - Single phase flowadvection-diffusion- Landfill cover systems- Design of Cover Systems – Daily Cover – Intermediate Cover – Final Cover - Flow through Landfill Covers- Design and Analysis of Slope Stability- Anchor Trenches- Access ramps - Erosion control

UNIT III LEACHATE AND LANDFILL GAS MANAGEMENT **9**

Waste decomposition in landfills - Factors affecting leachate and landfill gas generation – Factors affecting Leachate Quantity in active and post closure conditions- Hydrologic Evaluation of Landfill Performance (HELP) model – Leachate Drainage Layer – Geotextile and Geonet design – Leachate Collection and Removal systems-Temporal trends in leachate composition – Design of Landfill gas collection and removal systems- Gas condensate issues & knockouts - Leachate treatment methods (biological and physico-chemical)- Leachate re-circulation & bioreactor landfills- monitoring and control of leachate and Landfill gas- Landfill Settlement

UNIT IV LANDFILL OPERATION AND CLOSURE 9

Landfill Construction and Operational Controls – Fill Sequencing Plans – Cell Construction-Dozer and Compactor operations-Selection of Landfill Equipment- Landfill Administration-Record Keeping - Topographic mapping-Environmental Controls – Odour, Vector and Litter Control – Landfill Safety - Fire Control – Ground and Surface water Monitoring – Methane Gas monitoring - Audits of landfill environmental performance and management – Post Closure care and use of landfills – Landfill Economics- landfill construction and operational cost estimation – establishing tipping fees

UNIT V CONTAMINATED SITE REMEDIATION 9

Contaminated sites - Fate and behaviour of toxics and persistent substances in the environment – Engineering Issues in Site Remediation - Site Characterization - Framework for risk assessment at landfill sites - Remediation Principles: Source Control and Management of Migration Covers, Cutoff Walls, Solidification / Stabilization - Pump-and-Treat Systems - Solvent Vapor Extraction, Air Sparging, Soil Flushing – Bioremediation - Natural Attenuation - Remedy Selection and Risk Assessment – Geotechnical Aspects of In Situ Remediation Technology - Specific case studies in contaminated site remediation – Rehabilitation of Open dumps- Landfill Mining

REFERENCES:

1. Hari D Sharma and Krishna R. Reddy, Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Techonolgies, John Wiely, New Jersy, 2004.

2. Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation , Hari D Sharma Lewis Sharma.

3. Robert M. Koerner and Donald H Gray "Geotechnical aspects of Landfill Design and Construction", Prentice Hall, New Jersy.2002

4. Neal Bolton P.E “The Handbook of Landfill Operations”, Blue Ridge Services Inc., Atascadro, CA – ISBN 0-9646956 0-x, 1995

5. David E Daniel and Robert M. Koerner “Waste Containment Facilities –Guidance for construction Quality Assurance and Construction Quality Control of Liner and Cover Systems, American Socirty of Civil Engineers, ASCE Press.2007

6. . Donald L Wise and Debra J Trantolo, “Remediation of Hazardous Waste Contaminated Soils, Marcel Dekker Inc., New York,1994

7. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.

8. Oweis, I.S. and Khera, R.P *Geotechnology of Waste Management*, 2nd Edition, PWS Publishing Co., Boston, MA, 1998.

Course coordinator HOD

P18PEER043	PRINCIPLES OF ENVIRONMENTAL SCIENCE	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite course: Environmental studies				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES: -

To educate the students in the area of water air and soil chemistry and also microbiology of environment**.**

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of chemistry, mainly chemical kinetics and colloidal chemistry	U
CO2	To know the basics of biological systems in the Environment	R
CO3	To understand about the basics of microbiology of water, air and soil	U
CO4	To know about the Biomonitoring Methods	U
CO5	To understand Aquatic chemistry	Ap
CO6	To improve the knowledge on the fundamentals of atmospheric Chemistry and various regions of atmosphere	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**	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		3		2	1	
	CO2	1			2	3	1	1	2
	CO3		3	1	2		1		
	CO4		3	1	2			2	1
	CO5	2	3		2		1	1	
	CO6		2			1		3	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION **9**

Structure of Environment – interaction between biological and chemical components – Law of Mass Action – Chemical equilibria – Chemical kinetics – Colloidal Chemistry – catalysis and Photocatalysis – Corrosion and its control.

UNIT-IIBIOLOGICAL SYSTEMS **9**

Plants – Animals – distribution – interaction – biomass – classification – salient features – nutrients and microorganisms – environmental factors.

UNIT-III MICROBIOLOGY OF ENVIRONMENT **9**

Microbiology of water – soil – air. Indicator organisms, - coliforms – MPN index – M.F. technique – Biological indices. Biomonitoring methods – Eutrophication. Biological treatment of wastewater – bacterial reductions. Algae in water supply systems – problems and control. Macrophytes in water bodies –role – control.

UNIT-IV CHEMISTRY OF AQUATICS **9**

Common organic reactions – Enzymes and factors influencing enzymic reactions – Pesticides and syndets – Transformation and degradation of pollutants.

UNIT-V CHEMISTRY OF ATMOSPHERE **9**

Structure of the atmosphere – Photochemistry of the atmosphere – ozone layer depletion – Acid rain – Greenhouse gases and global warming.

REFERENCES:

1. C.N. Sawyer, P.L. MacCarty and G.F. Parkin, Chemistry for Environmental Engineering and Science, Tata Me Graw – Hill, fifth edition, New Delhi, 2003.
2. Biswarup Mukherjee, Environmental Biology, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 1997.
3. De.A.K. "Environmental Chemistry", New age International Ltd., New Delhi, 2001.
4. https://nptel.ac.in/courses/122/106/122106030/
5. https://nptel.ac.in/courses/105/107/105107173/
6. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/lecture-notes/

Course coordinator **HOD**

P18PEER044	**ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Industrial Waste Treatment and Disposal				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on principles related to Environment, Health and Safety systems in work places, occupational health and hygiene.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the Need for developing Environment, Health and Safety systems in work places	U
CO2	To understand about the occupational health and hygiene	U
CO3	To understand in detail about the workplace safety and safety systems	R
CO4	To improve the knowledge on Elements of a health and safety policy and methods of its effective implementation	E
CO5	To know about the Principles and methods of effective training in Environment, Health and Safety systems in work places	U
CO6	To understand the Principles of quality management systems in health and safety management	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	PSO1	PSO2	PSO3
2	CO1		2			1	1	2	1
	CO2		3	1	2	2	1	2	1
	CO3	2	3	1	1		1	2	1
	CO4		2	1		3	1	2	
	CO5		2		3	1	1	2	1
	CO6	1		3			1	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I INTRODUCTION 9

Need for developing Environment, Health and Safety systems in work places. Status and relationship of Acts, Regulations and Codes of Practice .Role of trade union safety representatives. International initiatives.Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Definition of the term occupational health and hygiene.Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

UNIT IV TECHNIQUES OF ENVIRONMENTAL SAFETY 9

Elements of a health and safety policy and methods of its effective implementation and review. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Relationship between quality manuals, safety policies and written risk assessments. 38Records and other documentation required by an organisation for health and safety. Industry specific EHS issues.

UNIT V EDUCATION AND TRAINING 9

Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

REFERENCES

1. Safety,Health and Environment Handbook,July 2017,K.T.Narayanan.
2. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995.
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
4. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

Course coordinator **HOD**

Programme Elective V (PE - V)

P18PEER051	**MARINE POLLUTION MONITORING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Coastal Engineering				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on aspects of marine pollution and methods of water quality assessment and marine pollution control

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of General features of oceans and principles of marine geology	U
CO2	To understand about the Living resources in and around the oceans	U
CO3	To understand in detail about the planning and preparation of marine Surveying and sea surveying which includes the oceanographic instrumentation	R
CO4	To improve the knowledge on the emerging trends of marine pollution applications of remote sensing and GIS in marine studies	E
CO5	To know about the control strategies of marine pollution associated with sustainable development	U
CO6	To know about the Human intervention in estuarine ecosystem	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	1	1	1
	CO2	1	3	1	2	2	3	1	1
	CO3		3	1	1	2	3	1	1
	CO4		2	1		3	3	1	1
	CO5	1	2		3	1	2	1	
	CO6						1		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I OCEANOGRAPHY **9**

General features of ocean- Conservation laws- Wave characteristics and theories- Sediment transport- Tides- ocean Currents- Thermocline circulation- General circulation of ocean waters, Tsunamis, Storm Surge- Principles of Marine geology

UNIT-II COASTAL ENVIRONMENT **9**

Living resources- coral reefs, mangroves, seagrass, seaweeds, fishery potential- nonliving resources- manganese nodules, heavy minerals-Beaches, Estuaries, Lagoons- Shoreline changes

UNIT-III MARINE SURVEYING **9**

Sea surveying planning and preparation- Oceanographic instrumentation- Hydrographic Surveying- Underwater surveying- Measurement of physical properties of ocean water- sea bad sampling

UNIT-IVMARINE POLLUTION AND MONITORING **9**

Physiochemical properties of sea water- Sources of marine pollution and impacts on coastal ecosystems, Oil pollution- oil spill detection, dispersion, impacts on adjacent area- Oil spill modeling, mitigation measures- Oil exploration and their effects- Marine outfalls- Impacts of Ports and Harbour on marine water quality- dredging- Human intervention in estuarine ecosystem- sea water classification- Physical modeling in Coastal Engineering-Ocean monitoring satellites- Applications of Remote sensing and GIS in marine studies

UNIT-VMARINE POLLUTION CONTROL **9**

National and International treaties, protocols in marine pollution- Exclusive Economic Zone- Sustainable development.

REFERENCES:

1.Kennish, M.J., Pollution impacts on Marine Biotic Communities, CRC press New York,1998.

2.Newman, M.C., Roberts Jr. M.H., Male R.C.(Editors), Coastal and Estuarine Risk Assessment, Lewis Publishers, Washington,D.C.,2002.

3.U.S. Army Corps of Engineers, Shore protection Manual, Washington D.C.,2002.

4.Marine pollution Dr.P. C.Sinha , Anmol Publications Pvt. Ltd, 1998.

Course coordinator **HOD**

P18PEER052	**REMOTE SENSING AND GIS FOR ENVIRONMENTAL APPLICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Remote Sensing and GIS				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the principles and application of remote sensing and GIS in environmental engineering.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the principles of Electro Magnetic Radiation and also the concepts of remote Sensing	U
CO2	To understand about the Remote Sensing Platforms,various sensors used and also about the various Indian space programmed satellite data products.	U
CO3	To understand in detail about the Data Processing and image processing techniques and softwares used in GIS.	R
CO4	To study about the introduction to GIS concepts and GIS softwares.	E
CO5	To study about coastal zone management and limitations	U
CO6	To know about the environmental applications of Remote Sensing and GIS	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	PSO1	PSO2	PSO3
2	CO1	3				1	1	2	1
	CO2	1		1	2	2	1	2	1
	CO3		2	1	1	2	1	2	1
	CO4			1		3	1	1	2
	CO5	1			3	1	1	1	1
	CO6		3		2		2	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I PRINCIPLES OF ELECTRO MAGNETIC RADIATION 9

Concepts of remote Sensing – Energy sources and radiation principles, Energy interactions in the atmosphere – Spectral reflectance of earth surface features

UNIT-II REMOTE SENSING PLATFORMS 9

Aerial photographs, photographic Systems – visual infra red and microwave sensing – active and passive sensors – satellites and their sensors, Indian space programmed satellite data products

UNIT-III DATA PROCESSING 9

Photogrammetric – satellite data analysis – visual interpretation equipments – digital image processing – image rectification, enhancement, classification, data merging and biophysical modeling – image processing software

UNIT-IV GEOGRAPHIC INFORMATION SYSTEM 9

Introduction to GIS concepts – Data base structure – Data analysis – GIS software

UNIT-VREMOTE SENSING AND GIS APPLICATIONS 9

Management and monitoring of environment, conservation of resources, coastal zone management – limitations

REFERENCES:

1.Remote Sensing Applications in Environmental Research , Mukherjee Islam Srivastava Gupta,2014.

2. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and image interpretation, John Wiley and Sons, New York,2004.

3. Burrough,P.A.and McDonnell, R.A., Principles of Geographic information systems, Oxford University press, New York,2001.

4. Linz. andSimonet, Remote Sensing of Environment, Addison Wesley publishing Company, New Jersey,1998.

Course coordinator HO

P18PEER053	**ENVIRONMENTAL POLICIES AND LEGISLATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering I				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To make them understand the fundamentals of environmental law and its relation with other disciplines of law.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand about basics of Indian Constitution and Environment and about various pollution control policies	U
CO2	To understand about basics of Indian Constitution and Environment and about various pollution control policies	U
CO3	To understand in detail about the Administrative regulation –India	R
CO4	To improve the knowledge on the various Pollution Control Laws and its amendments	E
CO5	To know about the relevant notifications in environmental (protection) act 1986 and their amendments in the subsequent years	U
CO6	To learn about the constitution of various state Pollution control boards	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	PSO1	PSO2	PSO3
2	CO1	1	2			1	1	2	1
	CO2		3	1	2	2	1	2	2
	CO3	2	3	1	1	2	1	2	2
	CO4		2	1		3	1	2	1
	CO5		2		3	1	1	2	2
	CO6			2	3		1	2	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I INTRODUCTION 9

Basics of jurisprudence- environmental law relation with other disciplines-criminal law-common law-relevant section of the code of civil procedure, criminal procedure code –Indian Penal Code.

UNIT-II INDIAN CONSTITUTION AND ENVIRONMENT 9

Introduction –fundamental rights-directive principles of state polices-Article 48 (A)and 51-A(g) Judicial enforceability – constitution and Resources management and pollution control-Indian forest policy(1990)-Indian environmental policy(1992).

UNIT-III ADMINSTRATIVE REGIME AND LEGAL REGIME 9

Administrative regulation –constitution of pollution control boards powers, functions accounts audit etc.-formal justice delivery mechanism higher and lower of judiciary-constitutional remedies writ jurisdiction article 32,226 136 special reference to mandamus and certiorari for pollution abatement- equitable remedies for pollution control.

UNIT-IVPOLLUTION CONTROL LAWS 9

Administrative regulation under recent legislation s in wear pollution control water (prevention & control of pollution) Act 1974 as amended by amendment Act 1988. water (prevention and control of pollution)Ruler 1975 water (prevention & control or pollution) Cess Act . 1977 as amended by amendment Act 1987 and relevant notifications.

UNIT-V ENVIRONMENTAL (PROTECTION) ACT 1986 9

Relevant notifications in connection with hazardous wastes (management and handling) biomedical wastes(management and management and handling), Nosing pollution , Eco-labelling, and E.I.A

REFERENCES:

1. Constitution of India Esastern Book Company Lucknow 12 thEdn. 1997.
2. Constitutional Law of India- J.N.Pandey 1997 (31stEdn.) Central Law Agency Allahabad.
3. Administrative Law U.P.D.Kesari 1998. Universal Book Trade Delhi.
4. Environmental Law H.N. Tiwari, Allahabad Law. Agency 1997.
5. Environmental, A.,Divan and Noble M. Environmental Law and Policy in India (cases,Materials and Statues) 1991 Tripathi Bombay.

6. Environmental Policy.Forest Policy. Bare Acts- Government Gazette Notification.

Course coordinator **HOD**

P18PEER054	**ADVANCED OXIDATION PROCESS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Environmental Engineering I, II				
	Course Coordinator Name & Department: Civil Engineering				

COURSE OBJECTIVES:-

To educate the students on the principles of various oxidation process needed for waste water treatment**.**

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To make them understand the fundamentals of AOPs for water and wastewater treatment	U
CO2	To understand about the various heterogeneous photocatalytic processes	U
CO3	To understand in detail about the homogeneous photocatalytic processes	U
CO4	To improve the knowledge on the various case studies and applications of semiconductor photolysis	Ap
CO5	To know about the industrial applications of AOPS	R
CO6	To know about the economic assessment of AOPS	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	PSO1	PSO2	PSO3
2	CO1	3	2			1	1	3	1
	CO2		3	1	2	2	2	3	1
	CO3		3	1	1	2	2	3	2
	CO4		2	1		3	1	3	1
	CO5	1	2		3	1	2	3	1
	CO6	2		3	2		2	3	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	OpenElective (OE)	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I INTRODUCTION TO AOPs **9**

Introduction to AOPs for water and wastewater treatment – mechanism – photo oxidation reactions – photocatalytic reactions, photo initiated oxidation – UV- H2O2 / ozonation, fenton / photofenton – photocatalysis – light source choice – used in AOPs and their spectral distributions.

UNIT II HETEROGENEOUS PROCESS **9**

Introduction to nano & heterogeneous photocatalysis effect of system composition and process. Identification of degradation products, Photoreactors (liquid phase/ gas phase) – solar/ artificial light photo reactors – operation of pilot plants – comparing reactor efficiencies – system design – solar collectors – technology issues – slurry, supported catalyst – reuse – novel photocatalysts, Synthesis methods – bulk, chemical approaches, physical approaches, nanoporous materials – physic chemical methods for characterization of nanomaterials.

UNIT III HOMOGENOUS AOPs **9**

Ozone, electro-chemical oxidation, ultrasonication, UV – Photolysis, Hydrogen Peroxide and Ultraviolet Radiation (H2O2/UV), Fenton and Photo Fenton‟s Oxidation, chemical and nonchemical AOPs, advantages and disadvantages of homogeneous processes.

UNIT IV ENHANCEMENT OF QUANTUM YIELD **9**

Non-thermal plasma-electron hydraulic cavitation and sonolysis- super water oxidation – γ rayselectron beams, Quantum yield improvement by additional oxidants – hydrogen peroxide persulphate– catalyst modification. case studies and applications semiconductor photolysis. Process fundamentals, applications and commercial process.

UNIT V INDUSTRIAL APPLICATIONS & ECONOMIC ASSESSMENT OF AOPs9

Application of AOPs for industries like textile, petroleum pharmaceutical and petrochemical industry. Ground water decontamination – drinking water treatment – pilot & land fill photochemical – cost calculation–economic analysis.

REFERENCES:

1. Wastewater Treatment Advanced processes and Technologies, Jul 2012**,**by D.G.Rao andR. Senthilkumar

2. Cao G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
3. Rose R. M., Shepard L. A.and Wulff J., “The Structure and Properties of Materials”, Wiley EasternLtd 4. Simon Parsons, "Advanced oxidation processes for water and wastewater treatment", IWA Publishing, 2004.
5. Thomas Oppenländer, "Photochemical Purification of Water and Air: Advanced Oxidation Processes (AOPs): Principles, Reaction Mechanisms, Reactor Concepts", Wiley-VCH Publishing, Published by, 2003.
6. Marta.I.Litter, RobertsJ.Candal,J.MartinMeichtry,"Advanced Oxidation Technologies: Sustainable Solution for Environmental Trearment , CRC,Press, 2014.

Course coordinator **HOD**

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.TECH – GEOTECHNICAL ENGINEERING
(FULL TIME) I – IV SEMESTERS

SEMESTER–I							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCGT101	Advanced Soil Mechanics	3	0	0	3
2	PC	P18PCGT102	Advanced Foundation Engineering	3	0	0	3
3	PE		Professional Elective– I	3	0	0	3
4	PE		Professional Elective– II	3	0	0	3
5	PR	P18PRGT101	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCGT1L1	Advanced Soil Mechanics Laboratory- I	0	0	2	2
7	PC	P18PCGT1L2	Computer Applications in Geotechnical Engineering-I	0	0	2	2
AUDIT COURSE							
8	AC		Audit Course - 1	2	0	0	0
			Total	**16**	**0**	**4**	**18**

SEMESTER–II							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCGT201	Dynamics of soils and foundations	3	0	0	3
2	PC	P18PCGT202	Subsurface investigations and instrumentation	3	0	0	3
3	PE		Professional Elective– III	3	0	0	3
4	PE		Professional Elective– IV	3	0	0	3
PRACTICAL							
5	PC	P18PCGT2L1	Advanced Soil Mechanics Laboratory- II	0	0	2	2
6	PC	P18PCGT2L2	Computer Applications in Geotechnical Engineering- II	0	0	2	2
7	PR	P18PRGT201	Mini Project	0	0	4	2
AUDIT COURSE							
8	AC		Audit Course – 2	2	0	0	0
			Total	**14**	**0**	**12**	**18**

SEMESTER -III							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	PE		Professional Elective- V	3	-	-	3
2	OE		Open Elective	3			3
3	PR	P18PRGT301	Dissertation Stage–I			20	10

			(to be continued next semester)				
			Total	**6**	**0**	**20**	**16**

SEMESTER–IV							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	PR	P18PRGT401	Dissertation Stage–II	0	0	32	16
			Total	**0**	**0**	**32**	**16**

Total Credits for the programme = 18 + 18 +16 +16 = 68

LIST OF PROFESSIONAL ELECTIVES

Professional Elective(PE-I)

S.No	Code	Subject Name	L	T	P	C
1	P18PEGT011	Soil Structure Interaction	3	0	0	3
2	P18PEGT012	Ground Improvement Techniques	3	0	0	3
3	P18PEGT013	Pavement Analysis and Design	3	0	0	3
4	P18PEGT014	Theoretical Soil Mechanics	3	0	0	3

Professional Elective(PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
1	P18PEGT021	FEM in Geomechanics	3	0	0	3
2	P18PEGT022	Environmental Geotechnology	3	0	0	3
3	P18PEGT023	Critical Soil Mechanics	3	0	0	3
4	P18PEGT024	Foundations on Expansive Soils	3	0	0	3

Professional Elective(PE-III)

1	P18PEGT031	Offshore Geotechnical Engineering / Marine Geotechniques	3	0	0	3
2	P18PEGT032	Computational Geomechanics	3	0	0	3
3	P18PEGT033	Engineering Rock Mechanics	3	0	0	3
4	P18PEGT034	Geosynthetic and Reinforced Soil Structures	3	0	0	3

Professional Electives(PE-IV)

1	P18PEGT041	Earth Retaining Structures	3	0	0	3
2	P18PEGT042	Design of Underground Excavations	3	0	0	3
3	P18PEGT043	Physical andConstitutiveModelling on Geomechanics	3	0	0	3
4	P18PEGT044	Mechanics of Unsaturated Soils	3	0	0	3

Professional Elective(PE-V)

1	P18PEGT051	Stability Analysis of Slopes	3	0	0	3
2	P18PEGT052	Foundations on Weak Rocks	3	0	0	3
3	P18PEGT053	Geotechnical Earthquake Engineering	3	0	0	3
4	P18PEGT054	Earth and Rock Fill Dams	3	0	0	3

List of Open Elective (OE)

S.No	Code No.	Course Title	L	T	P	C
1	P18OECS001	Business Analytics	3	0	0	3
2	P18OEMA002	Operational Research	3	0	0	3
3	P18OEME003	Industrial Safety	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	0	0	3
5	P18OEME005	Composite Materials	3	0	0	3
6	P18OEEE006	Waste to Energy	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	3	0	0	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

	Sub Area	Credit as per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics(PM)	3	-	-	-	3	4.4
2	Professional Core (PC)	6	6	-	-	12	17.6
3	Professional Electives (PE)	3	6	3	-	12	17.6
5	Open Electives (OE)	2	-	3	-	5	7.4
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)	4	6	10	16	36	53
	Total Credits	18	18	16	16	68	100
	Total Contact Hours	20	22	26	32	100 Hrs.	

SYLLABUS

SEMESTER I

P18PCGT101	**ADVANCED SOIL MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques therebyprotecting environment.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the characteristics strength of soil	U
CO2	To study the fluid flow for 1-d, 2-d and 3d seepage	U
CO3	To analyse the stresses in soil from surface loads	An
CO4	To evaluate the stress-strain relationship of soils	E
CO5	To study the applications of geotechnical physical modeling	Ap
CO6	To study the elastic and plastic deformations of a soil	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2	2	1	2	3	2	1
	CO2	3	3	3	1		2	1	1
	CO3	3	3	3		2	3		
	CO4	3	2	3			2		
	CO5	2	2	2	1		2	1	1
	CO6	2	2	2			2	1	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I COMPRESSIBILITYOFSOILS **9**

Consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylor's method)

UNIT II STRENGTH BEHAVIOROFSOILS **9**

Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

UNIT IIISTRESSPATH **9**

Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

UNIT IV CRITICAL STATESOIL MECHANICS **9**

Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane, Critical void ratio, effect of dilation in sands, different dilation models.

UNIT V ELASTIC AND PLASTICDEFORMATIONS **9**

Elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

REFERENCES:

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical soil mechanics, McGraw Hill, 1978.
2. Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- HillCo., 1993.
3. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition,1997.
4. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge UniversityPress, 1990.
5. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd.,1987.
6. Tezaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley &Sons, 1967.
7. Lmbe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.
8. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-361-advanced-soil-mechanics-fall-2004/lecture-notes/
9. https://nptel.ac.in/courses/105/101/105101001/
10. https://www.scribd.com/doc/299302589/Advanced-Soil-Mechanics-B-M-das

Course Coordinator **HOD**

P18PCGT102	**ADVANCED FOUNDATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- The student will be exposed to the design of piles, pile groups and coffer dams with respect to vertical and lateral loads for various field conditions.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the different methods of soil exploration and to study the field testing in soil	U

CO2	To study the bearing capacity of soil and to know about the components of settlement	R
CO3	To understand the pile classification and to learn about lateral and uplift load capacity ofpile	U
CO4	To know the structural design of pile and pile groups	An
CO5	To study about coffer dams, types, analysis and design.	An
CO6	To understandthe behavior of collapsible and expansive soil	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1	2	1	1	2	1	1
	CO2	2	1	3		1	2	2	1
	CO3	2	1	3		1	2	1	1
	CO4	3	2	1			3	1	
	CO5	3	2	1			3	2	
	CO6	2	1	1	1	1	2	1	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 SOIL EXPLORATION **9**

Planning of soil exploration for different projects, methods of subsurface exploration, methods of borings along with various penetration tests

UNIT II SHALLOW FOUNDATIONS 9

Requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes

.

UNIT III PILE FOUNDATIONS **9**

Methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

UNIT IV WELL FOUNDATION AND COFFERDAMS **9**

IS and IRC codal provisions, elastic theory and ultimate resistance methods, Coffer dams- various types, analysis and design foundations under uplifting loads

UNIT V FOUNDATIONS ONPROBLEMATICSOILS **9**

Foundations for collapsible and expansive soil

REFERENCES:

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn,1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980.
5. Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- HillCo., 1993.
6. https://nptel.ac.in/courses/105/108/105108069/
7. https://easyengineering.net/advanced-foundation-engineering-book/
8. https://lecturenotes.in/subject/244/advanced-foundation-engineering-afe

Course Coordinator **HOD**

P18PRGT101	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course:				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - At the end of this course, students will be able to understand research problem formulation and analyze research related information.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand research related information	U
CO2	To study and follow research ethics	R
CO3	To study today's world is controlled by computer and information technology	R
CO4	To study the information about Intellectual Property Right	R
CO5	To understand that IPR protection provides an incentive to inventors for further research work and investment in R & D	U
CO6	To understand the administration of patent system and new developments in IPR.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	3			1	1	1	
	CO2	1		3	1		1	2	1
	CO3		2	1	1		2		
	CO4	3	1	2			3	1	1
	CO5	2	1	1	1	1	2		2
	CO6	2	1			1	1	1	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 INTRODUCTION **9**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT II LITERATURE **9**

Effective literature studies approaches, Analysis of plagiarism, Research ethics.

UNIT III TECHNICAL WRITING **9**

Effective technical writing, writing report, paper development, research proposal, format of research proposal, presentation and assessment by review committee.

UNIT IVINTELLECTUAL PROPERTY **9**

Nature of intellectual property: Patents, Designs, Trade and Copyright, Process ofpatenting and development, technological research, innovation, patenting, development, International scenario, International cooperation on Intellectual Property, Procedurefor grants of patents, Patenting under PCT.

UNIT VPATENT RIGHTS **9**

Scope of patent rights, Licensing and transfer of technology, Patent information and databases Geographical indications, New developments in IPR, Administration of patent system, New developments in IPR, IPR of biological systems, Computer software etc., Traditional knowledge, Case studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science&
2. Engineeringstudents’
3. Wayne Goddard and Stuart Melville, “Research Methodology: AnIntroduction”
4. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide forbeginners”
5. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007. Mayall , “Industrial Design”, McGraw Hill,1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand,2008
10. http://svpcet.org/research-methodology-and-intellectual-property-rights-18mc0101/
11. https://shodhganga.inflibnet.ac.in/bitstream/10603/55615/11/11_chapter%203.pdf
12. https://lecturenotes.in/m/21513-research-methodology-

Course Coordinator **HOD**

P18PCGT1L1	**ADVANCED SOIL MECHANICS LABORATORY - I**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**4**	**2**
	Prerequisite course: Soil Mechanics Lab				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- Attheendofthecourse student attainsadequateknowledgein assessing index properties,compaction,CBR,Compressibility,Swellcharacteristics and permeability of soils by conducting laboratorytests.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	Tocarry out index tests on soil	P
CO2	To carry out visual classification testson soil	P
CO3	To analyse the classification of soil.	M
CO4	To solve practical problems related compaction and CBR tests on soil	COR
CO5	To determine the permeability of soil	GR
CO6	To study the consolidation of soil	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2	2			3	2	1
	CO2	2		1		1	2	1	
	CO3	2	2	1		2	2	1	1
	CO4	3	2	1			3	2	1
	CO5	2					2		
	CO6	2		2		2	2	1	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

List of practicals:

1. Determination of moisture content and specific gravity ofsoil
2. Grain size distribution analysis and hydrometer analysis
3. Atterberg'slimits (Liquid limit, Plastic limit, Shrinkagelimit)
4. Visual classification tests
5. Vibration test for relative density ofsand
6. Standard and modified proctor compactiontest

7. Falling head permeability test and constant head permeability test
8. Consolidationtest

REFERENCES:

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi,2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London1990.
3. Head, K.H., Manual of Soil Laboratory Testing Vol.III, Second Edition, John Wiley & Sons, 1998.
4. Bowles, J.E., Engineering properties of soils and their measurements, McGraw Hill,1992.
5. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin,1997
6. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
7. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Cooperative Society, Chennai, 1996.
8. Lambe T.W., Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
9. I.S. Code of Practice (2720): Relevant Parts, as amended from time totime.
10. http://en.sutech.ac.ir/cee/laboratories/advanced-soil-mechanics-laboratory/
11. https://www.cedengineering.com/userfiles/Soil%20Mechanics%20-%20%20Laboratory%20Testing.pdf
12. https://www.goodreads.com/book/show/14866667-advanced-soil-mechanics-laboratory-testing

Course Coordinator **HOD**

P18PCGT1L2	**COMPUTER APPLICATIONS IN GEOTECHNICAENGINEERING LAB-I**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**4**	**2**
	Prerequisite course: Computer Aided Building Drawing				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To have a fundamental knowledge of various software packages	P
CO2	To study about drawings of foundations	P
CO3	To learn about design and drawing for irrigation structures.	M
CO4	To have a fundamental knowledge of the design of ground improvement methods	COR
CO5	To analyze the structure using Software	S
CO6	To apply earth pressure theories on retaining walls related problems	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2			2	1	2	2	1
	CO2	2				1	2	2	
	CO3	2	3	2			3	1	1

	CO4	3		3			3	2	1
	CO5	3	2				3		
	CO6	3	2	3			2	2	1
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

List of Practicals:

Analyze and design of real challenging problems such as foundations and retaining walls, and ground improvement related problems.

1. Earth pressuretest
2. Load settlement analysis
3. Pile load test
4. Pile group test
5. Spread footing design

REFERENCES:

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2), CBS Publishers and Distributors, NewDelhi,2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London1990.
3. Head, K.H., Manual of Soil Laboratory Testing Vol.III, Second Edition, John Wiley& Sons, 1998.
4. Bowles, J.E., Engineering properties of soils and their measurements, McGraw Hill, 1992.
5. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin,1997
6. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
7. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Cooperative Society, Chennai, 1996.
8. Lambe T.W., Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
9. I.S. Code of Practice (2720): Relevant Parts, as amended from time totime.
10. https://www.sciencedirect.com/science/article/abs/pii/016636159390025V
11. https://www.epfl.ch/labs/lms/wp-content/uploads/2018/08/Book_ASCE_157.pdf
12. https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0031324

Course Coordinator **HOD**

SEMESTER II

P18PCGT201	**DYNAMICS OF SOILS AND FOUNDATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- The student will be exposed to the design of piles, pile groups and coffer dams with respect to vertical and lateral loads for various field conditions.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study about the theory of vibration.	R
CO2	To understand about the dynamic soil properties and behavior	U
CO3	To learn about the types of machines and foundations	R
CO4	To study the dynamic analysis of impact type machines	An
CO5	To understand the influence of vibration and remediation	U
CO6	To study the bearing capacity of dynamically loaded foundations	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3		1			3	1	
	CO2	3	1	1			2	1	1
	CO3	3	2		1		2	1	
	CO4	3					3	1	
	CO5	2	1	1	1		1	1	
	CO6	2	1	2			2	2	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 FUNDAMENTALS OFVIBRATIONS **9**

Single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments, Wave propagation**:** elastic continuum medium, semi-infinite elastic continuum medium, soil behaviour under dynamic loading.

UNIT II LIQUEFACTION OFSOILS **9**

Liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential.

UNIT III DYNAMIC ELASTIC CONSTANTSOFSOIL **9**

Determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests and oscillatory shear box test

UNIT IV MACHINE FOUNDATIONS **9**

Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

UNIT V BEARING CAPACITYOFFOUNDATIONS **9**

Introduction to bearing capacity of dynamically loaded foundations such as those of water towers, chimneys and high rise buildings, response of pile foundations

REFERENCES:

1. Das, B.M., "Fundamentals of Soil Dynamics", Elsevier, 1983.
2. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson, 2008.
3. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
4. KameswaraRao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, PrenticeHall Inc., 1970.
6. Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley& Sons, 1998.
7. https://nptel.ac.in/courses/105/101/105101005/
8. https://lecturenotes.in/m/25383-soil-dynamics-and-machine-foundation
9. https://ascelibrary.org/doi/book/10.1061/9780784413425

Course Coordinator **HOD**

P18PCGT202	**SUBSURFACE INVESTIGATION ANDINSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:-Students are expected to understand the importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design suitable foundation system.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the different methods of exploration	R
CO2	To understand the exploration techniques	U
CO3	To know about the soil sampling	R
CO4	To study the field testing in soil exploration	E
CO5	To know the application of instrumentation in soil engineering	Ap
CO6	To understand the pore pressure measurements in soil	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2		3	2		3	1	1
	CO2	2		1	1		3	2	1
	CO3		2		1		2	1	
	CO4	2		1	1		3	1	1
	CO5		2	1	2		2	1	
	CO6	2	3				2		
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT 1 PLANNING OF EXPLORATION AND**GEOPHYSICALMETHODS** **9**

Scope and objectives, planning an exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic method, Multichannel Analysis of Surface Waves *(*MASW*)* method and electrical methods, cross bore hole, single bore hole – up hole - down holemethods.

UNIT II EXPLORATIONTECHNIQUES **7**

Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, limitations of various drilling techniques, stabilization of boreholes, bore logs.

UNIT III SOILSAMPLING **8**

Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling ofsamples.

UNIT IV FIELD TESTING I**NSOILEXPLORATION** **12**

Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, corrections and data interpretation of allmethods

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 - slope indicators, sensing units, casestudies.

REFERENCES:

1. Hunt R.E., Geotechnical Engineering Investigation Manual, McGrawHill, 1984.
2. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold1994.
3. Alam Singh and Chowdhary, G.R.Soil Engineering in Theory and Practice, Volume-2, Geotechnical testing and instrumentation, CBS Publishers and Distributors, New Delhi, 2006.

4. Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter-worths, 1987.
5. Dunnicliff, J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.
6. Hanna, T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.
7. Day, R.N., Geotechnical and Foundation Engineering, Design and Construction, McGraw-Hill, 1999.
8. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill International Edition, 1997.
9. Clayton C. R. I., Matthews M. C. and Simons N. E., Site Investigation, Second Edition Halsted Press,1982
10. Schnaid, F., "In Situ Testing in Geo-mechanics", Taylor andFrancis.
11. http://geosystems.ce.gatech.edu/Faculty/Mayne/papers/NHI%202002%20Subsurface%20Investigations.pdf
12. http://www.dot.state.mn.us/materials/manuals/geotechnical/geotechnicalmanual2017.pdf
13. https://www.ardaman.com/civil-engineering/geotechnical-investigation/

Course Coordinator **HOD**

P18PCGT2L1	**ADVANCED SOIL MECHANICS LABORATORY - II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Soil Mechanics Lab				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- At the end of the course student attains adequate knowledge in assessing Shear Strength, dynamic properties of soil and shear strength, indirect tensile strength and compressive strength of Rocks. Student learns to assess the different properties of geosynthetics. Student is trained to gainknowledge in assessing the properties of soils through field tests and also byconducting model tests.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To estimate the strength parameters of any type of soil	P
CO2	To solve soil water characteristic problems	P
CO3	To carry out the test on properties of geosynthetics	M
CO4	To carry out the test on rocks	COR
CO5	To analyse the model test on foundation elements	S
CO6	To apply the geosynthetics properties in field	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2	1			3	1	
	CO2	3	1			1	3	2	
	CO3	3	2	1			2		1
	CO4	3	1	1			2		
	CO5	3	2				3	1	
	CO6	3	1	1		1	2	1	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

List of Practicals:

1. Direct sheartest
2. Triaxial compression (UU and CU)test
3. Unconfined compressiontest
4. Vane sheartest
5. Opening size of geotextiles
6. Tensile strength of geosyntheticmaterials
7. Interfacial friction test
8. Permeability test
9. Point loadindex
10. Braziliantest
11. Direct sheartest
12. Uniaxial compressive strengthtest
13. Plate load test
14. Static cone penetration test
15. Standard penetration test (Demonstrationonly)
16. Block vibration test (Demonstrationonly)
17. Cyclic triaxial test (Demonstrationonly)

REFERENCES:

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi, 2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London1990.
3. Head, K.H., Manual of Soil Laboratory Testing Vol.III, Second Edition, JohnWiley & Sons, 1998.
4. Bowles, J.E., Engineering properties of soils and their measurements, McGraw Hill, 1992.
5. KameswaraRao, N.S.V., Dynamics Soil Tests and Applications, Wheeler Publishing, New Delhi, 2000.
6. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press,Austin,1997
7. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering &Soil Testing, Sounders College Publishing, Fort Worth, 1992.
8. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
9. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Co-operative Society, Chennai, 1996.
10. Lambe T.W., Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
11. I.S. Code of Practice (2720): Relevant Parts, as amended from time totime.
12. http://en.sutech.ac.ir/cee/laboratories/advanced-soil-mechanics-laboratory/
13. https://www.cedengineering.com/userfiles/Soil%20Mechanics%20-%20%20Laboratory%20Testing.pdf
14. https://www.goodreads.com/book/show/14866667-advanced-soil-mechanics-laboratory-testing

Course Coordinator **HOD**

P18PCGT2L2	**COMPUTER APPLICATIONS INGEOTECHNICA ENGINEERING LAB-II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Computer Aided Building Drawing				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To have a fundamental knowledge of the design of irrigation structures.	P
CO2	To study about drawing such as foundations.	P
CO3	To learn about design and drawing for deep foundation	M
CO4	To have a fundamental knowledge of the design embankment or surcharge adjacent to an existing structure which can describe real life phenomena	COR
CO5	To analysis the structure using software	S
CO6	To study about various type of retaining walls and ground improvement	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1			1	3	2	1
	CO2	2	2	2			2	1	
	CO3	3	2	2			2	1	
	CO4	3	2				3	2	1
	CO5	2	2				3	1	
	CO6	2	2			2	2	1	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

Software used to analyze and design real challenging problems such as design and drawing for deep foundation, deep excavation adjacent to an existing structure and slope stability analysis. Also, to predict the response of any other field problems like an embankment or surcharge adjacent to an existing structure.

List of Practicals:

1. Slope stability analysis
2. Sheet pile analysis

3. Earth pressure analysis
4. Micro pile analysis
5. Settlement analysis
6. Field Test dataanalysist

REFERENCES:

1. Alam Singh andChowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi, 2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London1990.
3. Head, K.H., Manual of Soil Laboratory Testing Vol.III, Second Edition, John Wiley& Sons, 1998
4. Bowles, J.E., Engineering properties of soils and their measurements, McGraw Hill, 1992.
5. KameswaraRao, N.S.V., Dynamics Soil Tests and Applications, Wheeler Publishing, New Delhi, 2000.
6. https://www.sciencedirect.com/science/article/abs/pii/016636159390025V
7. https://www.epfl.ch/labs/lms/wp-content/uploads/2018/08/Book_ASCE_157.pdf
8. https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0031324

Course Coordinator **HOD**

P18PRGT201	**MINI PROJECT**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**0**	**0**	**4**	**2**
	Prerequisite course: B.E/B.Tech in Civil Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- To provide exposure to the students to 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	Identify geotechnical engineering problems reviewing available literature.	P
CO2	Study different techniques used to analyze various structural systems.	P
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	M
CO4	To do practical experiments based on his /her projects.	COR
CO5	To understand the case study experiments for his /her projects	S
CO6	To submit the project in a full form report	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3			2	3	1	
	CO2		3				2	2	1
	CO3	3	3				3	1	
	CO4		3	2		2	3	1	1
	CO5		2	2			3		1

	CO6	2	2			3	2	2	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**			
4	Approval	Meeting of Academic Council, May 2018							

Syllabus Contents:

Mini Project will have mid semester presentation 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 of mini project at mid semester and end semester will be monitored by the departmental committee.

Course Coordinator **HOD**

SEMESTER III

P18PRGT301	**DISSERTATION STAGE - I**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**0**	**0**	**20**	**10**
	Prerequisite course: Mini Project				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To provide exposure to the students to 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	Identify geotechnical engineering problems reviewing available literature.	P
CO2	Study different techniques used to analyze various structural systems.	P
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	M
CO4	To do practical experiments based on his /her projects.	COR
CO5	To understand the case study experiments for his /her projects	S
CO6	To submit the project in a full form report	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3			2	3	1	
	CO2		3				2	2	1
	CO3	3	3				3	1	
	CO4		3	2		2	3	1	1
	CO5		2	2			3		1
	CO6	2	2			3	2	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation-I will have mid semester presentation 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 and must bring out individualscontribution.

Continuous assessment of Dissertation – I at Mid semester and End semester will be monitored by the departmental committee.

Course Coordinator **HOD**

SEMESTER IV

P18PRGT401	**DISSERTATION STAGE - II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**0**	**0**	**32**	**16**
	Prerequisite course: Dissertation Stage - I				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To provide exposure to the students to 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	Identify geotechnical engineering problems reviewing available literature.	P
CO2	Study different techniques used to analyze various structural systems.	P
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	M
CO4	To do practical experiments based on his /her projects.	COR
CO5	To understand the case study experiments for his /her projects	S
CO6	To submit the project in a full form report	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3			2	3	1	
	CO2		3				2	2	1
	CO3	3	3				3	1	
	CO4		3	2		2	3	1	1
	CO5		2	2			3		1
	CO6	2	2			3	2	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation – II will be extension of the work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc.There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Continuous assessment of Dissertation – II at Mid semester and End semester will be monitored by the departmental committee.

Course Coordinator **HOD**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I (PE – I)

P18PEGT011	**SOIL STRUCTURE INTERACTION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics & Foundations Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES:- Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loadingconditions.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the soil response models of interaction analysis	U
CO2	To study the infinite and finite beams on elastic foundations	R
CO3	To study the plate on elastic medium using ACI method	R
CO4	To analysis the pile and pile groups using design charts	An
CO5	To find the deflection of lateral loaded pile	An
CO6	To understand the load deflection behavior of laterally loaded piles	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2	1			3	2	
	CO2	3	1				2	1	
	CO3	2	2	1			2	2	1
	CO4	2	3				3	2	
	CO5	3	1				2	1	1
	CO6	3	1	1			2	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 SOIL-FOUNDATIONINTERACTION **9**

Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behavior, and Time dependent behavior

UNIT II BEAM ONELASTICFOUNDATION **9**

Soil Models: Infinite beam, two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT III PLATE ON ELASTICMEDIUM **9**

Thin and thick plates, analysis of finite plates, numerical analysis of finite plates and simple solutions

UNIT IV ELASTIC ANALYSISOFPILE **9**

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap

UNIT V LATERALLY LOADEDPILE **9**

Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads

REFERENCES:

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, JohnWiley, 1980. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
3. Structure Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
4. ACI 336. (1988), Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute.
5. https://www.nehrp.gov/pdf/nistgcr12-917-21.pdf
6. https://nptel.ac.in/courses/105/105/105105200/
7. https://www.researchgate.net/publication/226685681_Soil_Structure_Interaction_in_Practice

Course Coordinator **HOD**

P18PEGT012	**GROUND IMPROVEMENT TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Building Construction				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as designtechniques required to implement various ground improvement methods.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To learn the scope and necessity of ground improvement.	U
CO2	To study the compaction and sand drains	R
CO3	To know about the stone column, lime piles and soil nailing	R
CO4	To study the geosynthetics and its applications	Ap
CO5	To have a clear understanding about the grouting method.	U
CO6	To study the various functions of geotextiles and application to ground anchors	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2	1			3		
	CO2	1			2	1	2	1	
	CO3	2	1	2		2	1	1	
	CO4	1	2		1	1	3	2	1
	CO5	1	2	1			1	1	1
	CO6	1		1	1	1	2		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I PROBLEMATIC SOIL AND GROUNDIMPROVEMENTTECHNIQUES 9

Ground improvement - Role of ground improvement in foundation engineering, Methods of ground improvement, Geotechnical problems in black cotton soils, Selection of suitable ground improvement techniques based on soil conditions.

UNIT II DEWATEREING 9

Dewatering Techniques - Well points, Vacuum and electro-osmotic methods, Seepage analysis for two dimensional flow - fully and partially penetrated slots in homogeneous deposits (Simple cases only)

UNIT III GROUND IMPROVEMENT FOR COHESIONLESS ANDCOHESIVESOILS 9

In-situ densification of cohesion-less soils and consolidation of cohesive soils: Dynamic compaction Vibro-flotation, Sand compaction piles. Consolidation: Preloading with sand drains, and fabric drains, Stone columns, Lime piles-installation techniques only – relative merits and limitations – deep soil mixing

UNIT IV GROUTINGTECHNIQUE 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 GEOSYNTHETICSAPPLICATIONS 9

Geosynthetics - Functions of Geotextiles – Separation – Filtration – Drainage - reinforcement - Geomembranes - Containments and barriers - Application to Ground Anchors.

REFERENCES:

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-HillInternational Editions, 1990.
2. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing,A.A. Balkema, 1966.
3. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
4. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement,John Wiley & Sons,1994.
5. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc.1998.
6. Shukla, S.K., Yin, Jian-Hua, “Fundamentals of Geosynthetic Engineering”, Taylor &Francis

7. https://nptel.ac.in/courses/105/108/105108075/
8. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_GIT_NOTES_0.pdf
9. https://theconstructor.org/geotechnical/ground-improvement-techniques-soil-stabilization/1836/

Course Coordinator **HO**

P18PEGT013	**PAVEMENT ANALYSIS AND DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Transportation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions ofroads.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the historical development of pavements, types & classification.	U
CO2	To learn the factors affecting flexible pavements	R
CO3	To learn the design flexible and rigid pavements using IRC methods	R
CO4	To suggests modern material, pavement evaluation and rehabilitation	Ap
CO5	To evaluate and carry out stabilization of soils for road constructions	E
CO6	To study the application of geosynthetics in pavements.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2				2	1	
	CO2		1	2			2		
	CO3	3	2		1		3	2	1
	CO4	3	2	1	1	1	2	1	1
	CO5	2	3	1			2	1	
	CO6	1		1		1	2		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 DESIGNPHILOSOPHY **9**

Introduction to highway pavements, Types and component parts of pavements, Factors affecting design and performance of pavements, Functions and significance of sub grade properties, various methods of assessment of sub grade soil strength for pavement design, Mix design procedures in

Mechanical stabilization of soils, Design of bituminous mixes by Marshall, Hubbard - field and Hveem'smethods

UNIT II FLEXIBLEPAVEMENTS **9**

Introduction to analysis and design of flexible pavements, Stresses and deflections in homogeneous masses, Burmister's 2 layer and 3 layer theories, Wheel load stresses, ESWL of multiple wheels, Repeated loads and EWL factors, Empirical, semi - empirical and theoretical approaches for flexible pavement design, Group index, CBR, Triaxial, Mcleod and Burmister's layered system methods, Selection of– traffic loading andvolume.

UNIT III RIGIDPAVEMENTS **9**

Introductiontoanalysisanddesignofrigidpavements,Typesofstressesandcauses,Factorsinfluencing stresses, General conditions in rigid pavement analysis, Warping stresses, Frictional stresses, combined stresses, IRC methods of design.

UNIT IV MATERIAL CHARACTERIZATIONOFPAVEMENTS **9**

Joints in cement concrete pavements, Joint spacing, Design of slab thickness, Design and detailing of longitudinal, contraction and expansion joints, drainage, failure criteria, reliability, Quality control tests for highway pavements.

UNIT V: EVALUATIONOFPAVEMENTS **9**

Introduction to pavement evaluation, Structural and functional requirements of flexible and rigid pavements, Evaluation of pavement structural condition by Benkelman beam, rebound deflection and plate load tests, Introduction to design of pavement overlays and the use of geosynthetics, drainage system.

REFERENCES:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
3. Sharma and Sharma, Principles and Practice of Highway Engg, Asia PublishingHouse, 1980.
4. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.
5. IRC: 37 - 2001, 'Guidelines for the Design of FlexiblePavements'.
6. IRC: 58 – 2002, 'Guidelines for the Design of RigidPavements'.
7. IRC: 37-2012, 'Tentative Guidelines for the Design of FlexiblePavements'.
8. IRC: 58-2011, Guidelines for Design of Plain Jointed Rigid Pavements for highways.
9. https://easyengineering.net/pavement-analysis-and-design-book-pdf/
10. https://lecturenotes.in/download/note/22383-note-for-pavement-design-pd-by-sunitha-reddy
11. https://www.researchgate.net/publication/331424699_Pavement_Analysis_and_Design_by_Multiphysics

Course Coordinator **HOD**

P18PEGT014	**THEORETICAL SOIL MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To impart knowledge required for computing stress and settlement at any point in the semi-infinite elastic soil medium, anisotropic medium and layered deposits due to foundation loads and evaluation of stability of foundations, slopes, cuts and retaining structures both for the conditions of undrained and drained loadingthrough theorems of plastic collapses.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the material behavior	U
CO2	To analysis the stress and displacement in soils	An
CO3	To understand the theory of plasticity in soils	U
CO4	To evaluate the stability of soil structures	E

CO5	To study the application of steady state condition in porous media							Ap	
CO6	To study the flow through porous media and in flownets							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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2	2			1	2	1
	CO2	3	1				3	2	1
	CO3	2	1	2			2	1	
	CO4	3	2				3	2	1
	CO5	1		2	1		2		
	CO6	2	1		1		1		
3	Category	Professional Mathematics (PM)		Professional Core (PC)	**Professional Elective (PE)**		Open Elective (OE)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT 1 THEORYO**FELASTICITY** **9**

Material behavior – Basic Concepts – Elastic, Viscous andPlastic idealization, Mechanics of Continua: Stress and strain - concept of stress and strain – Three dimensional and Two dimensional state of stress – Plane stress, plane strain and axisymmetric problems – equilibrium and compatibility conditions, constitutive relations, stress functions – Two dimensional problems in Cartesian and polarco-ordinates.

UNIT II STRESSA**ND DISPLACEMENT** I**N EASTIC – HALFSPACEMEDIUM** **9**

Elastic half-space medium – Stress by external loads – Isotropic, anisotropic and non-homogeneous elastic continuum – Boussinesq, Frochlich, Westergaard solutions for force on the surface of semi-infinite medium – Kelvin, Cerruti and Mindlin's method for force in interior of semi-infinite medium, solutions by influence charts – Elastic displacement – Layered soil – Burmistermethod.

UNIT III THEOREMS OF PLASTIC COLLAPSE ANDTHEIRAPPLICATIONS **9**

Perfect plastic material-theory of plasticity – Hardening law, flow rule, Theorem of plastic collapse – bound theorems – Mechanism for plane plastic collapse – slip fans, stress fans – discontinuities – Simple solutions for undrained and drained loading – Stability of foundations, retaining walls, slopes andcuts.

UNIT IV STABILITY OF SOIL STRUCTURE BY SLIP LINE METHOD AND LIMIT EQUILIBRIUMANALYSIS **9**

Introduction – stress –strain relationship in a perfectly plastic material – discontinuousslipping – Stress and displacement field calculations – associatedfield calculation – Slip line solutions for undrained and drained conditions – limit equilibrium solutions for stability of foundation, retaining

walls and slopes.

UNIT V FLOW THROUGHPOROUS MEDIA **9**

Flow through porous media – Darcy'slaw –General equation of flow, seepagethroughisotropic anisotropic and non-homogeneous conditions – Steady state condition, confined and unconfined flow – solution by flow net – seepage pressure – piping.

REFERENCES:

1. Aysen, A., Problem solving in Soil Mechanics, Taylor & Francis, London, First Indian Print,2011.
2. Chowdhury, I., Dasgupta S.P., Dynamics of Structure and Foundations, Taylor & Francis Group, London, 2009.
3. Bolton, M.D; A Guide to Soil Mechanics, University press (India) Pvt.Ltd.,2009
4. Atkinson, J.H; Mechanics of Soils and Foundations, Taylor and Francis, London, 2007.
5. Aysen, A., Soil Mechanics, Basic concepts and Engineering Applications, A.A.Balkema Publishers, 2002.
6. Ulrich Smoltc, YK, Geotechnical Engineering Handbook (Vol.1), Ernot&Sohn, 2002.
7. https://easyengineering.net/theoretical-soil-mechanics-book-pdf-by/
8. https://www.researchgate.net/publication/228028489_Theoretical_Soil_Mechanics
9. http://library.um.ac.id/free-contents/index.php/buku/detail/foundation-of-theoretical-soil-mechanics-m-e-harr-1518.html

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE II (PE – II)

P18PEGT021	**FEM IN GEOMECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Structural Analysis-I				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To study the energy principles, finite element concept, stressanalysis, Meshing, linear problems and applications.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study concepts of piecewise approximation and finite elements	R
CO2	To know about two dimensional problems in stress analysis	An
CO3	To understand the meshing and solution problems.	U
CO4	To evaluate the nonlinear and vibration problems.	E
CO5	To understand the application to different geotechnical problems.	Ap
CO6	To learn the Terzaghi's consolidation theory to analyze the settlement.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1	3		1	2	1	1
	CO2	3	2	1	1	1	3	2	1
	CO3	3	2	2			2	2	
	CO4	3	2	1			3	1	
	CO5	3	3	1	1		2	2	1
	CO6	3	2		1	2	3	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1STRESS –DEFORMATIONANALYSIS **9**

Stress-deformation analysis: One dimensional, Two dimensional and Three-dimensional formulations.

UNIT II STRESSESANDSTRAINS **9**

Discretization of a Continuum, Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms.

UNIT III STIFFNESSFORMULATION **9**

Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.

UNIT IV DISPLACEMENT FORMULATION **9**

Displacement formulation for rectangular, triangular and isoparametric elements for two dimensional and axisymmetric stress analysis

UNITVCONSOLIDATIONAND SETTLEMENT **9**

Settlement Analysis, 2-D elastic solutions for homogeneous, isotropic medium, Steady seepage analysis: Finite element solutions of Laplace's equation, Consolidation analysis: Terzaghi's consolidation problem, Choice of soil properties for finite element analysis.

REFERENCES:

1. O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol I &Vol II,McGraw Hill,1989,1992.
2. K.J. Bathe, Finite element procedures, PHI Ltd., 1996.
3. David M Potts and LidijaZdravkovic, "Finite Element Analysis in GeotechnicalEngineering Theory and Application", Thomas Telford. 1999
4. https://www.researchgate.net/publication/297512034_Stochastic_finite_element_method_in_geomechanics
5. https://www.onepetro.org/conference-paper/SPE-79694-MS
6. http://geomechanics.civil.northwestern.edu/Presentations_files/plaxis.pdf

Course Coordinator **HOD**

P18PEGT022	**ENVIRONMENTAL GEOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Geotechnical Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediatethecontaminatedsoilsbydifferenttechniquestherebyprotecting environment.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand the soil-environment interaction	U
CO2	To study the mineralogical characterization.	R
CO3	To analyse the influence of organic and inorganic chemical interaction.	An
CO4	To understand the contaminant transport phenomenon and remediation techniques	U
CO5	To apply the differenttechniques for stabilization of waste	Ap
CO6	To evaluate the rational approach for remediation of contaminated sites	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2	1		1	2	1	1
	CO2	2	1	2			1	2	1
	CO3	3	2		1	1	3	1	

	CO4	2	1	2			1	2	
	CO5	3	1	2	1	1	2		
	CO6	3	2	1			3		1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT I SOIL –POLLUTANTINTERACTION **9**

Introduction to geo-environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction – failures of foundations due to pollutants – case studies.

UNIT II SITE SELECTION AND SAFE DISPOSALOFWASTE **9**

Safe disposal of waste – site selection for landfills – characterization of land fill sites – waste characterization – stability of landfills – current practice of waste disposal – passive containment system – application of geo synthetics in solid waste management – rigid or flexibleliners

UNIT III TRANSPORTOFCONTAMINANTS **9**

Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – foundation for waste fill ground – pollution of aquifers by mixing of liquid waste – protectingaquifers.

UNIT IV WASTE STABILIZATIONANDDISPOSAL **9**

Hazardous waste control and storage system – stabilization/ solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification – mechanism of stabilization – organic and inorganic stabilization – utilization of solid waste for soil improvement.

UNIT V REMEDIATION OF CONTAMINATEDSOILS **9**

Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soilheating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well.

REFERENCES:

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and SonsInc., 2005. Fang, H-Y., Introduction to Environmental Geotechnology, CRCPress, 1997.
2. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
3. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for WasteDisposal Facilities, E & FN Spon, 1995.
4. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
5. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles andApplications, Marcel Dekker Inc, 2000.
6. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilizationand Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.
7. https://nptel.ac.in/courses/105/102/105102160/
8. https://www.icevirtuallibrary.com/toc/jenge/current
9. https://lecturenotes.in/subject/1009

Course Coordinator **HOD**

P18PEGT023	**CRITICAL SOIL MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - At the completion of the course the students will be able to decide the type of mathematical models to be used for analyzing the behavior of soil mass at criticalstate.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the soil behavior	R
CO2	To understand the drained and undrained surfaces of soils	U
CO3	To analyse the stress and displacement in soils	An
CO4	To understand the behavior of over consolidated samples.	U
CO5	To study the behaviour of sands	R
CO6	To evaluate the elastic and plastic deformations and study about plasticity theory	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1	2			2	2	1
	CO2	1	2				2		1
	CO3	3	1	1		1	3	1	
	CO4	2	1				1		1
	CO5	2	1				1		1
	CO6	3	2	1		1	3	2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I SOIL BEHAVIOR **9**

State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments

UNIT II THE CRITICAL STATE LINE AND THEROSCOE SURFACE **9**

Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface.

UNIT III BEHAVIOR OFOVERCONSOLIDATEDSAMPLES **9**

The Hvorslev surface: Behaviour of overconsolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes.

UNIT IV BEHAVIOUR OFSANDS **9**

The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model

UNIT V BEHAVIOUR OF SOILSBEFORE FAILURE **9**

Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, the Cam-clay model, the modified Cam-clay model

REFERENCES:

1. J. H. Atkinson and P. L. Bransby, "The mechanics of soils: An introduction to criticalstate soil mechanics", McGraw Hill,1978
2. D. M. Wood, "Soil behaviour and critical state soil mechanics", Cambridge UniversityPress, 1990
3. B. M. Das, "Fundamental of geotechnical engineering", Cengage Learning,2013
4. https://easyengineering.net/soil-behaviour-and-critical-state-soi/
5. http://www-civ.eng.cam.ac.uk/geotech_new/publications/schofield_wroth_1968.pdf
6. http://www.mycrisp.com/docs/csmechs.pdf

Course Coordinator **HOD**

P18PEGT024	**FOUNDATION ON EXPANSIVE SOILS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To get exposure about various aspects of structures especially constructed on expansive soil. To understand various methods of stabilization usedinexpansivesoils.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the general principles in foundation.	R
CO2	To analyze swelling characteristics by laboratory tests.	An
CO3	To understand the techniques for controlling swelling in soil.	U
CO4	To study the foundations on expansive soils.	R
CO5	To learn the modification of swelling characteristics.	R
CO6	To apply the method of chemical stabilization in 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	1	1			3	1	
	CO2	3	2				3	1	2
	CO3	2	2	1		1	2		1
	CO4	2	1				2	1	

	CO5	1	1			1	1	2	
	CO6	2	1	2			2		1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT1 GENERALPRINCIPLES **9**

Origin of expansive soils – Physical properties of expansive soils – Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

UNIT II SWELLINGCHARACTERISTICS **9**

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave

UNIT III TECHNIQUES FORCONTROLLINGSWELLING **9**

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique

UNIT IV FOUNDATIONS ONEXPANSIVESOILS **9**

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

UNIT V: MODIFICATION OFSWELLINGCHARACTERISTICS **9**

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization in Construction.

REFERENCES:

1. FU HUA CHEN, “Foundations on Expansive Soils”, Elsevier Scientific PublishingCompany, NewYork.
2. GopalRanjan&A.S.RRao, “Basic and Applied Soil Mechanics”, New Age InternationalPublishers – New Delhi.
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI,Roorkee
4. IS: 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure ofSoils.
5. R.K.Katti, “Search for Solutions in ExpansiveSoils”.
6. Alam Singh, “Modern Geotechnical Engineering”, Geo-Environ Academia,Jodhapur.
7. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBH, NewDelhi.
8. http://www5.unitn.it/Biblioteca/it/Web/EngibankFile/703982.pdf
9. https://www.ladbs.org/docs/default-source/publications/information-bulletins/building-code/foundation-design-for-expansive-soils-ib-p-bc2017-116.pdf?sfvrsn=18
10. https://www.wbdg.org/FFC/ARMYCOE/COETM/ARCHIVES/tm_5_818_7.pdf

Course Coordinator **HOD**

PROFESSIONALELECTIVE (PE – III)

P18PEGT031	**OFFSHORE GEOTECHNICAL ENGINEERING/ MARINE GEOTECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: -Students are expected to understand the importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design marinestructures and its foundation system.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the physical and engineering properties of marine soils	R
CO2	To understand the behavior of sands and clays under cyclic loading	U
CO3	To know the recent advancements in site investigation and sampling used for marine soil deposits	U
CO4	To understand about the different offshore and near shore foundations	U
CO5	To study the numerical modeling of cyclic behavior of soils	R
CO6	To apply FEM analysis to marine foundations subjected to wave loading	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		2		3	1	
	CO2	3	1	2			3	1	
	CO3	2	1		2	1	2		1
	CO4	3	2	1			3	1	
	CO5	3	2				2	3	
	CO6	3	1	2	1		2	2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I MARINESOIL DEPOSITS **9**

Offshore environment, offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils.

UNIT II BEHAVIOR OF SOILS SUBJECTED TOREPEATEDLOADING **9**

Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases.

UNIT III SITE INVESTIGATION IN THE CASE OF MARINESOIL DEPOSITS 9

Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits.

UNIT IV FOUNDATIONS IN MARINESOIL DEPOSITS 9

Different offshore and nearshore foundations, Gravity platforms, Jack-up rigs, pile foundations. Caissons, spud cans.

UNIT V NUMERICAL MODELING OF MARINE FOUNDATIONS SUBJECTED TO WAVELOADING 9

Numerical modeling of cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

REFERENCES:

1. H. G. Poulos. "Marine Geotechnics", Unwin Hyman Ltd, London, UK,1988
2. D. V. Reddy and M. Arockiasamy, "Offshore Structures", Volume: 1, R.E. KreigerPuband Co.,1991
3. D. Thomson and D. J. Beasley, "Handbook of Marine Geotechnical Engineering", USNavy, 2012
4. https://www.researchgate.net/publication/255889113_Offshore_Geotechnical_Engineering
5. https://apps.dtic.mil/dtic/tr/fulltext/u2/a556807.pdf
6. https://www.fugro.com/our-services/marine-site-characterisation/marine-geotechnics/offshore-geotechnical-engineering

Course Coordinator **HOD**

P18PEGT032	**COMPUTATIONAL GEOMECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: FEM in Geomechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Students are expected to understand the importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design marine.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the solution of linear and non-linear equations.	R
CO2	To understand the finite difference method and finite element method.	U
CO3	To know the correlation and regression analysis.	An
CO4	To understand the theory of consolidation.	U
CO5	To study **f**low through porous media.	R
CO6	To apply the finite difference solution procedure for multilayered 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2		1		2		
	CO2	3	1	1			3	2	
	CO3	3	2				2	1	1
	CO4	2	1	2			3	1	1
	CO5	2	1				2		
	CO6	3	2	1	2		2		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT 1 SOLUTION OF LINEAR ANDNON-LINEAREQUATIONS 9

Jacobi's method, Gauss Seidal method, Successive over relaxation method, Bisection, False Position, Newton-Raphson, Successive approximation method, Iterativemethods

UNIT II FINITE DIFFERENCE METHOD AND FINITEELEMENTMETHOD 9

Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations, Fundamentals, Constitutive finite element models for soils.

UNIT III CORRELATION ANDREGRESSIONANALYSIS 9

Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

UNIT IV ONE-DIMENSIONALCONSOLIDATION 9

Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems, Finite elementformulation

UNIT V FLOW THROUGHPOROUSMEDIA 9

Geotechnical aspects, Numerical methods, Applications and Design analysis, Flow in jointed media.

REFERENCES:

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, NewDelhi.
3. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge Press Ltd.,UK.
4. Sam Helwany, "Applied soil mechanics", John Wiley & sons, Inc.,
5. https://irispublishers.com/ctcse/pdf/CTCSE.MS.ID.000506.pdf
6. https://www.springer.com/gp/book/9780792334071

7. https://www.newcastle.edu.au/research-and-innovation/centre/prcgse/research/computational-geomechanics2

Course Coordinator **HOD**

P18PEGT033	**ENGINEERING ROCK MECHANICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Engineering Earth Science				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Students are expected to classify, understand stares-straincharacteristics,failure criteria, and influence of insitu stress in the stability of various structures and various technique to improve the insitu strength of rocks.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the classification of rocks.	R
CO2	To learn about the laboratory and field tests of rocks.	U
CO3	To analyze the strength criteria of rocks.	An
CO4	To understand the slope stability and bearing capacity of rocks.	U
CO5	To study the reinforcement of fractured and joined rocks.	R
CO6	To apply the rock mechanics in tunneling.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2	1	1		1	1	
	CO2	2	3		1	1	2	2	1
	CO3	3	1				3	1	
	CO4	3	1		1		3	2	1
	CO5	1	2	1			1	2	1
	CO6	2	1	1	1		2	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I ROCK **9**

Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; Insitu stresses in rock

UNIT II ROCKTESTING **9**

Laboratory and Field tests, Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior

UNIT III DISCONTINUITIES INROCKMASSES **9**

Discontinuity orientation, Effect of discontinuities on strength of rock

UNIT IV STRENGTH/FAILURE CRITERION **9**

Mohr-Coulomb, Griffith theory, Hoek and Brown, Strength and other strength criteria, Stresses in rock near underground openings

UNIT V APPLICATION OF ROCK MECHANICS INCIVIL ENGINEERING **9**

Rock tunneling, Rock slope stability, bolting, blasting, grouting and rock foundation.

REFERENCES:

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to thePrinciples, 1997. Elsevier,Oxford
2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt.Ltd.
3. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
4. Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.
5. https://sites.google.com/site/farterswedlo/engineering-rock-mechanics---an-introduction-to-the-73122954
6. http://home.iitk.ac.in/~sarv/New%20Folder/Presentation1.pdf
7. https://engineeringstudymaterial.net/ebook/engineering-rock-mechanics-introduction-to-the-principles/

Course Coordinator **HOD**

P18PEGT034	**GEOSYNTHETIC AND REINFORCED SOIL STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To understand the mechanism of the reinforcement, its influence in the shear strength and design concept for various applications in geotechnical engineering.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study about the materials used in reinforced soil structures	R
CO2	To understand about the design for soil reinforcement and separation	U
CO3	To study about the basal reinforcement in embankments	R
CO4	To analyse the concepts of filtration mechanisms and filtration design	An
CO5	To learn the functions of reinforcement against slope failure & Stability	R
CO6	To study the application of geosynthetics in slopes	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		1	1	1	2	1
	CO2	3	1	2			3	1	

	CO3	1	2		2		1	2	
	CO4	3	1				3	2	
	CO5	1	2	2			2	1	1
	CO6	2	2		1	1	2	1	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT 1 PRINCIPLES AND MECHANISMS OFSOILREINFORCEMENT **9**

Historical Background – Principles - Concepts and Mechanisms of reinforced earth – Soil – Geosynthetics interaction mechanism – interface resistance – Factors influencing interaction – Strain compatibility. To learn the concepts and mechanisms of reinforced earth, soil a n d geosyntheticsinteraction.

UNIT II REINFORCING MATERIALS A**NDTHEIR PROPERTIES** **9**

Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers - facing elements – Influence of environmental factors on the performance of Geosynthetic materials – Physical – Mechanical – Hydraulic and Endurance propertiestesting.

UNIT III DESIGN F**OR SOIL REINFORCEMENT**A**NDSEPARATION** **9**

Reinforcing the soil, Geotextiles and Geogrids, Retaining wall, Embankments, Basalreinforcement, Piledembankment, unpaved roads, pavedroads, Railwaytracks, Shallow foundations and Seismic aspects

–

UNIT IV DESIGN FOR FILTRATION, DRAINAGEANDCONTAINMENT **9**

Geotextile filter – Filtration Mechanism – Factors affecting filter behaviour – Filtration design – Drains – Drainage in embankments – erosion control silt fences – Containment ponds – Reservoirs and Canals – Hydraulic tunnels – River bed and bankprotection.

UNIT V DESIGNOFSLOPES **9**

Types and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability analysis – Design aspects – Seismic aspects – General construction aspects

REFERENCES:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London,1996.
2. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London,1992.
3. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall,1997.
4. Muller, W.W. HDPE Geomembranes in Geotechnics, Springer, New York2007.
5. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London,1987.
6. SivakumarBabu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad,2006.
7. Kerry Rowe.R., "Geotechnical and Geo-Environmental Engineering handbook" Kluwer Academic Publishers,2001
8. Cheng.Y.M.,Lau.C.K., "Slope Stability Analysis and Stabilization" Routledge Taylor & Francis Group, London. 2008.
9. Sanjay Kumar Shukla., "Handbook of Geosynthetic Engineering" ICE publishing, London., Second edition.,2012

10. https://www.youtube.com/playlist?list=PLbMVogVj5nJRG9ucybzSZgGvkp2Ot0D6q
11. http://www.ktunotes.in/ktu-s8-civil-notes/
12. https://edurev.in/studytube/Geosynthetics-and-Reinforced-Soil-Structures-Power/124411c7-26fd-43cc-a4b0-5bcc6b55c4c5_p

Course Coordinator **HOD**

PROGRAMME ELECTIVE (PE – IV)

P18PEGT041	**EARTH RETAINING STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - At the end of this course, students are expected to analyze and design rigid, flexible earth retaining structures, slurry supported trenches and deepcuts.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the earth pressure theories	R
CO2	To evaluate stability of retaining structures	E
CO3	To study the behavior of sheet pile walls	R
CO4	To learn the analysis of supported excavations	An
CO5	To study the behavior of stability of slopes	R
CO6	To apply the earth pressure theories against bracings in cuts	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2		1		3	1	
	CO2	3	2	1		1	2	1	
	CO3	2	1	1			2		1
	CO4	3	2		1		3	1	
	CO5	2	1	1		1	2		1
	CO6	2	1	2			2	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 EARTHPRESSURE **9**

Rankine's and Coulomb's theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturatedbackfill.

UNIT II RETAININGWALLS **9**

Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

UNIT III SHEET PILE WALLSANDBULKHEADS **9**

Sheet Pile walls with free earth system and fixed earth system, bulkheads with free and fixed earth

supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates

UNIT IV TUNNELANDCONDUIT **9**

Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils,

UNIT V BRACEDEXCAVATIONS **9**

Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays

REFERENCES:

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing.1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn,1997.
3. https://nptel.ac.in/content/storage2/courses/105101083/download/lec26.pdf
4. http://site.iugaza.edu.ps/ymadhoun/files/2016/09/Chapter-13.pdf
5. http://www.ce-ref.com/Foundation/Retaining_wall/Ret_stability/Retain_stability.html

Course Coordinator **HOD**

P18PEGT042	**DESIGN OF UNDERGROUND EXCAVATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Students mainly focused in visualizing and critically analyzing thebehaviorof underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure on the underground structures.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand planning of and exploration for various underground constructionproject	U
CO2	To study the stress distribution around tunnels analysis of underground openings	R
CO3	To learn the analysis of underground openings	An
CO4	To understand the design of various support systems for tunneling	U
CO5	To learn about the instrumentation and monitoring of underground excavations,	R
CO6	To apply hydraulic fracturing and over coring techniques in the construction of tunnels	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		1		3	2	1
	CO2	3	2	1			3	1	1
	CO3	3	1	1			2	1	
	CO4	3	1	1			3	1	
	CO5	2	2		1		2	2	1
	CO6	2	2	1			2	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I INTRODUCTION **9**

Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT II STRESS DISTRIBUTION **9**

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openingsand openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory.

UNIT III ANALYSIS OFUNDERGROUNDOPENINGS **9**

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT IV DESIGN OFTUNNELS **9**

Rock mass-tunnel support interaction analysis, Ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, Design of various support systems including concrete and shotcrete linings, Steel sets, Rock bolting and rock anchoring, Combined support systems, Estimation of load carrying capacity of rock bolts.

UNIT V CONSTRUCTIONOFTUNNELS **9**

In-situ stress, Flat jack, Hydraulic fracturing and over coring techniques and USBM type Drill hole deformation gauge, Single and multi-point bore hole extensometers, Load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies

REFERENCES:

1. Hoek, E and Brown, E. T.," Underground Excavations in Rocks", Institute ofMining Engineering.
2. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks",John Wiley. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
3. Singh, B. and Goel, R.K., "Tunneling in Weak Rocks", Elsevier
4. https://www.onepetro.org/conference-paper/ARMA-66-0167
5. http://www.geotehnika.ba/e-casopis/3_1.pdf
6. https://www.researchgate.net/publication/223575721_Stress_instability_and_design_of_underground_excavations

Course Coordinator **HOD**

P18PEGT043	PHYSICAL AND CONSTITUTIVE MODELLING ON GEOMECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite course: FEM in Geomechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Students can understand theory of plasticity and various yield criteria and flow rule. Students can apply critical state concept to consolidation and triaxial soil behavior.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the role of constitutive modeling	U
CO2	To study the plasticity basics	R
CO3	To know the critical state soil mechanics	R
CO4	To understand the theory of consolidation	U
CO5	To understand **w**ork hardening and plasticity theory	U
CO6	To learn applications of elasto-plasticmodels	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1				2		
	CO2	1	2	2			2	1	
	CO3	3	1	1			3	1	1
	CO4	2	3		2		3	2	1
	CO5	1	1				2		
	CO6	2	2	1			2		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 ROLE OF CONSTITUTIVE MODELING **9**

Importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic

UNIT II PLASTICITY BASICS **9**

Yield criteria, flow rule, plastic potential, hardening/softening; Rate dependent Plasticity, Mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models.

UNIT III CRITICAL STATE SOIL MECHANICS **9**

Critical state concept, Cam clay models, Simulation of single element test using cam clay.

UNIT IV CONSOLIDATION **9**

Drained and undrained triaxial test; Stress dilatancy theory

UNIT V WORK HARDENING AND PLASTICITY THEORY **9**

Formulation and implementation; Applications of elasto-plastic models; Special Topics: hypo-elasticity-plasticity disturbed stateconcept.

REFERENCES:

1. Hicher and Shao, "Constitutive Modeling of Soils and Rocks", John Wiley.2008
2. C.S. Desai and H. J. Siriwardane, "Constitutive Laws for Engineering Materials with Emphasis on Geologic Materials", Prentice-Hall, Inc., New Jersey.1984
3. David M Potts and LidijaZdravkovic, "Finite Element Analysis in Geotechnical Engineering Theory and Application", Thomas Telford.1999
4. C.S. Desai, "Mechanics of Materials and Interfaces: The Disturbed State Concept", CRC Press LLC. 2000
5. A.P.S. Selvadurai, M.J. Boulon, "Mechanics of Geo-material Interfaces, Elsevier
6. .https://www.semanticscholar.org/paper/Multi-physical-processes-in-geomechanics-%E2%80%93-an-to-Charlier-Dizier/61826517ab3de7ad2e27da8af3eace4d93b24176
7. https://www.youtube.com/watch?v=_lSDk26YhVE

Course Coordinator **HOD**

P18PEGT044	MECHANICS OF UNSATURATED SOILS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - To impart knowledge in assessing both physical and engineering behaviour of unsaturatedsoils, measurement and modeling of suction, water content and suction, hydraulic conductivity of unsaturatedsoils.

COURSE OUTCOMES (COs)		Revised Bloom's Taxonomy
CO1	To study the state of unsaturated soil	U
CO2	To study the physical properties of Air and water	R
CO3	To study the stress state variables and shear strength	R
CO4	To learn the concept of permeability and hydraulic conductivity	U
CO5	To learn about the measurement of total suction	U
CO6	To study about soil water characteristic curves and Hydraulic conductivitymodels.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1	1			2	1	2
	CO2	1	2		1	2	2	1	
	CO3	3	1	2			3		1
	CO4	3	1		2		3	2	1
	CO5	2			1		2		
	CO6	2	2	1		1	3	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I STATE OFUNSATURATEDSOIL **9**

Definition – Interdisciplinary nature of unsaturated soil – soil classification – Nature and practice – stress profiles, stress state variables - material variables – constitutive law – suctionpotential of soil water

UNIT II PHYSICS OF SOILWATERSYSTEM **9**

Physical properties of Air and water – partial pressure and relative Humidity Density of moist air – surface Tension – cavitation of water, Solubility of air in water – Air – water solid interface – vapor pressure lowering – Soil water characteristic curve - Capillary tube model – contacting sphere model - Young Laplace equation – Height of capillary rise – Rate of capillary rise – capillary pore size distribution – theoretical basis – determination – laboratory method.

UNIT III STRESS STATE VARIABLES ANDSHEAR STRENGTH **9**

Effective-stress – stress between two spherical particles – Hysteresis in SWCC – stress parameter, stress tensor – stress control by Axis Translation - analytical representation of stress – volume change characteristics. Extended Mohr –Coulomb criterion – shear strength parameters – Interpretation of Direct shear test results and Tri axial test results – unified representation of failure envelope – Influence of suction in earth pressuredistribution.

UNIT IV STEADY ANDTRANSIENTFLOWS **9**

Driving mechanism – Permeability and Hydraulic conductivity – capillary barriers – steady infiltration and evaporation – Vapor flow – Air diffusion in water -Principles for pore liquid flow – Rate of infiltration, Transient suction and moisture profiles. Principles for Pore Gas flow – Barometric pumpingAnalysis.

UNIT V MATERIAL VARIABLE MEASUREMENTANDMODELLING **9**

Measurement of total suction – psychrometers – Filter paper measurement of matric suction – High Air Entry disks – Direct measurements – Tensiometers – Air-translation technique – Indirect measurements – Thermal conductivity sensors – measurement of osmotic suction – squeezing technique – soil water characteristic curves and Hydraulic conductivitymodels.

REFERENCES:

1. Fredlund, D.G., Rahardjo, H. and Fredlund, M.D., Unsaturated Soil Mechanics in Engineering Practice, John Wiley & Sons, INC, New Jersey,2012.
2. Ning Lu and William, J. Likes, Unsaturated Soil Mechanics, John Wiley & sons, INC. New Jersey, 2004
3. Ng Charles, W.W., Menzies Bruce, Advanced unsaturated Soil Mechanism and Engineering, Taylor & Francis Group, 2007.
4. Ning Lu, Laureano R. Hoyes and Lakshmi Reddi, Advances in unsaturated soil, seepage and Environmental Geotechnics, ASCE., Geotechnical special publicationNo.148.
5. Jean- Louis Briaud., Geotechnical Engineering: Unsaturated and Saturated soils, John Wiley & Sons, INC, New Jersey, 2013.
6. https://www.researchgate.net/publication/262353348_Mechanics_of_unsaturated_soils_for_the_design_of_foundation_structures
7. https://webapps.unitn.it/Biblioteca/it/Web/EngibankFile/1784834.pdf

8. https://nptel.ac.in/courses/105/103/105103139/

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE (PE – V)

	STABILITY ANALYSIS OF SLOPES	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
P18PEGT051	Prerequisite course: Soil Mechanics				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Student will be able to check the stability of earthen dams, and the safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To understand causes of slope failures, mechanics of slope failure	U
CO2	To study the concept of factor of safety	R
CO3	To learn the analysis of two dimensional flow and influence of seepage on slope	An
CO4	To learn the design of various strengthening measures	U
CO5	To learn about the instrumentation and monitoring of slopes	U
CO6	To apply various methods for stabilization of slopes.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2			1	2	1	2
	CO2	3	1	2			3	1	
	CO3	3	2	1			3	2	1
	CO4	3	1	1	1		3	2	1
	CO5	2	1		1	2	2	1	
	CO6	2	1	2			2	2	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 SLOPES **9**

Types and causes of slope failure, mechanics of slope failure, failure modes

UNIT II STABILITYANALYSIS **9**

Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method

UNIT III STABILITY ANALYSIS IN THE PRESENCEOFSEEPAGE 9

Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability analysis of dam body during steady seepage.

UNIT IV STRENGTHENINGMEASURES 9

Stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring.

UNIT VMAINTENANCEOFSLOPES 9

Instrumentation and monitoring of slope, slope movements, warning devices

REFERENCES:

1. Chowdhary R and Chowdhary. I , "Geotechnical Slope Analysis", CRCPress.
2. Harr M.E.," Ground Water and Seepage", McGraw Hill.1962
3. https://nptel.ac.in/content/storage2/courses/105101001/downloads/L19.pdf
4. https://www.cedengineering.com/userfiles/Intro%20to%20Slope%20Stability%20Analysis.pdf
5. http://www.limitstate.com/geo-manual-v3/geoManualch10.html

Course Coordinator **HOD**

P18PEGT052	**FOUNDATIONS ON WEAK ROCKS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Thestudentswillbeabletoclassifydifferenttypesofrockmassand design different types of foundations placed over rock mass.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To study the classification of rocks.	U
CO2	To learn about the failure criteria for weak rocks	R
CO3	To study the in-situ shear strength of rocks and rock masses	U
CO4	To understand the slope stability and bearing capacity of rocks	U
CO5	To study the piles in stratified rock masses	U
CO6	To analyze the bearing capacity and settlement of piles	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1				2	1	1
	CO2	3	2			1	3	2	1
	CO3	3	1	3			3	1	
	CO4	2	2		2		2	2	1

	CO5	2	1	1		1	2	2	
	CO6	3	2	1			3	2	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT I ENGINEERING PROPERTIES OFWEAKROCKS **9**

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits, Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

UNIT II FAILURE MODES **9**

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

UNIT III BEARINGCAPACITY **9**

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests, Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity and in-elasticity.

UNIT IV SHALLOWFOUNDATIONS **9**

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc., treatment of foundations - open joints, solution cavities, weak seams.

UNIT V PILES INWEAKROCKS **9**

Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks.

REFERENCES:

1. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FN Spon, Taylor and Francis.
2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier,Oxford.
3. Singh, B. and Goel, R.K. "Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd. Hoek, E., "Practical Rock Engineering", Rockscience.
5. https://www.cedengineering.com/userfiles/Rock%20Foundations.pdf
6. https://sites.google.com/site/advtechnovation/CIRIA-bookshop/book-pages/r181
7. http://home.iitk.ac.in/~sarv/New%20Folder/Presentation-14.pdf

Course Coordinator **HOD**

P18PEGT053	**GEOTECHNICAL EARTHQUAKE ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Basics of Dynamics and Seismic Design				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: - Thestudentswillbeabletoclassifydifferenttypesofrockmassand design different types of foundations placed over rock mass.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To learn the mechanism and causes of earthquakes	U
CO2	To learn the principles of vibration measuring instruments effect of transient and pulsating loads	R
CO3	To learn the concepts of ground motion characteristics	U
CO4	To study the concepts of design ground motion and to develop design ground motion	U
CO5	To learn about the evaluation of slope stability	U
CO6	To apply seismic design for retaining walls	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	2			2	3	2	1
	CO2	3	2	1			1	1	
	CO3	3	1	1		1	3	2	1
	CO4	3	1	1			3	2	
	CO5	3	2	1			2	1	
	CO6	3	1	1			2	3	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1 EARTHQUAKE SEISMOLOGY **9**

Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II EARTHQUAKEGROUNDMOTION **9**

Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design

UNIT III GROUND RESPONSEANALYSIS **9**

One-dimensional ground response analysis: Linear approaches,Equivalent linear approximation of non-linear approaches, Computer code "SHAKE".

UNIT IV LIQUEFACTION ANDLATERAL SPREADING **9**

Liquefaction related phenomena, Liquefactionsusceptibility: Historical, Geological, Compositional and State criteria. Evaluation ofliquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V SEISMIC DESIGNOFFOUNDATIONS **9**

Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

REFERENCES:

1. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson, 2008.
2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A.A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of NavalFacilities service Centre, Port Hueneme, 1997.
5. https://www.academia.edu/40212054/Geotechnical_Earthquake_Engineering_by_Steven_L_Kramer
6. https://manual-solutions.co/downloads/engineering-exam/solution-manual-for-geotechnical-earthquake-engineering-by-steven-l-kramer/

Course Coordinator **HOD**

P18PEGT054	**EARTH AND ROCK FILL DAMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Foundation Engineering				
	Course Coordinator Name & Department: Department of Civil Engineering				

COURSE OBJECTIVES: -Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniquesto protect the slopes.

COURSE OUTCOMES (COs)		**Revised Bloom's Taxonomy**
CO1	To learn the types of earth and rock fill dams	U
CO2	To study the slope stability and seepage analysis	R
CO3	To understand themechanisms inhydraulicfracturing	U
CO4	To study the failure and damages	U
CO5	To analysis the special design problems	An
CO6	To apply slope protection measures to earth dams	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1			1	2	1	
	CO2	3	2				3	2	1
	CO3	2	1	1			3	1	
	CO4	2	2		1		2	1	

	CO5	3	2	1			3	2	1
	CO6	2	2	1		1	2	1	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT1 DESIGNCONSIDERATION **9**

Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control porepressure.

UNIT II SLOPE STABILITY ANDSEEPAGEANALYSIS **9**

Stability of infinite and finite slopes, Method of Slices, Bishop's method, Flow nets, Stability conditions during construction, Full reservoir and drawdown - cut off walls – Trenches – Importance of drainage andfilters.

UNIT III HYDRAULICFRACTURING **9**

Introduction, Conditions and mechanisms for hydraulic fracturing, Failure criterion for hydraulic fracturing – cubic specimen with a crack – core with a transverse crack – core with a vertical crack, strike–dip of easiest crack spreading; factors affecting hydraulic fracturing, self- healing of a corecrack.

UNIT IV FAILUREANDDAMAGES **9**

Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersivepiping.

UNIT V SLOPEPROTECTIONMEASURES **9**

Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of geosynthetic materials in filtration, Treatment of rock foundation, construction techniques, quality control and performancemeasurement.

REFERENCES:

1. Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., Earth and Earth rock dam, John Wiley, 1963.
2. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.
3. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
4. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics,Sixth Edition, Prentice Hall, 2002.
1. Bramhead,E.N., the Stability of Slopes,Blacky Academic and Professionals Publications, Glasgow, 1986.
2. Chandhar, R.J., Engineering Developments and Applications, Thomas Telford,1991
3. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
4. Jun-Jie Wang, Hydraulic Fracturing in Earth-rock Fill Dams, John Wiley & Sons,2014.
5. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-2300.pdf
6. https://civilpddc2013.weebly.com/uploads/2/2/5/5/22556782/20_-_earthen_dams_and_rockfill_dams.pdf
7. https://www.intechopen.com/online-first/geotechnical-engineering-applied-on-earth-and-rock-fill-dams

Course Coordinator **HOD**

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.TECH – STRUCTURAL ENGINEERING
(FULL TIME) I – IV SEMESTERS

SEMESTER–I							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCST101	Advanced Structural Analysis	3	0	0	3
2	PC	P18PCST102	Advanced Solid Mechanics	3	0	0	3
3	PE		Professional Elective – I	3	0	0	3
4	PE		Professional Elective – II	3	0	0	3
5	PR	P18PRST101	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCST1L1	Structural Design Lab	0	0	2	2
7	PC	P18PCST1L2	Advanced Concrete Lab	0	0	2	2
AUDIT COURSE							
8	Audit 1		Audit Course - 1	2	0	0	0
			Total	**16**	**0**	**4**	**18**

SEMESTER–II							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCST201	FEM in Structural Engineering	3	0	0	3
2	PC	P18PCST202	Structural Dynamics	3	0	0	3
3	PE		Professional Elective – III	3	0	0	3
4	PE		Professional Elective – IV	3	0	0	3
PRACTICAL							
5	PC	P18PCST2L1	Model Testing Lab	0	0	2	2
6	PC	P18PCST2L2	Numerical Analysis Lab	0	0	2	2
7	PR	P18PRST201	Mini Project	0	0	4	2
AUDIT COURSE							
8	Audit 2		Audit Course – 2	2	0	0	0
			Total	**14**	**0**	**8**	**18**

SEMESTER–III							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	PE		Professional Elective - V	3	0	0	3
2	OE		Open Elective	3	0	0	3

3	PR	P18PRST301	Dissertation Phase – I	0	0	20	10
			Total	**6**	**0**	**20**	**16**
SEMESTER–IV							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	PR	P18PRST401	Dissertation Phase – II	0	0	32	16
			Total	**0**	**0**	**32**	**16**

Total Credit for the programme = 18+18+16+16=68

LIST OF PROFESSIONAL ELECTIVES

Professional Electives (PE-I)

S.No	Code	Subject Name	L	T	P	C
1	P18PEST011	Theory of Thin Plates and Shells	3	0	0	3
2	P18PEST012	Theory & Applications of cement composites	3	0	0	3
3	P18PEST013	Theory of Structural Stability	3	0	0	3
4	P18PEST014	Environmental Engineering Structures	3	0	0	3

Professional Electives (PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
1	P18PEST021	Analytical and Numerical Methods for Structural Engineering	3	0	0	3
2	P18PEST022	Structural Health Monitoring	3	0	0	3
3	P18PEST023	Structural Optimization	3	0	0	3
4	P18PEST024	Disaster Resistant Structures	3	0	0	3

Professional Electives (PE-III)

1	P18PEST031	Advanced Steel Design	3	0	0	3
2	P18PEST032	Design of Formwork	3	0	0	3
3	P18PEST033	Design of High Rise Structures	3	0	0	3
4	P18PEST034	Design of Masonry Structures	3	0	0	3

Professional Electives (PE-IV)

1	P18PEST041	Design of Advanced Concrete Structures	3	0	0	3
2	P18PEST042	Advanced Design of Foundations	3	0	0	3
3	P18PEST043	Soil Structure Interaction	3	0	0	3
4	P18PEST044	Design of Industrial Structure	3	0	0	3

Professional Electives (PE-V)

1	P18PEST051	Design of Pre-stressed Concrete Structures	3	0	0	3
2	P18PEST052	Analysis of Laminated Composite Plates	3	0	0	3
3	P18PEST053	Fracture Mechanics of Concrete Structures	3	0	0	3
4	P18PEST054	Design of Plates and Shells	3	0	0	3

List of Open Elective (OE)

S.No	Code No.	Course Title	L	T	P	C
1	P18OECS001	Business Analytics	3	0	0	3
2	P18OEMA002	Operational Research	3	0	0	3
3	P18OEME003	Industrial Safety	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	0	0	3
5	P18OEME005	Composite Materials	3	0	0	3
6	P18OEEE006	Waste to Energy	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	3	0	0	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

	Sub Area	Credit as per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics(PM)	3	-	-	-	3	4.4
2	Professional Core (PC)	6	6	-	-	12	17.6
3	Professional Electives (PE)	3	6	3	-	12	17.6
5	Open Electives (OE)	2	-	3	-	5	7.4
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)	4	6	10	16	36	53
	Total Credits	18	18	16	16	68	100
	Total Contact Hours	20	22	26	32	100 Hrs	

SYLLABUS
SEMESTER I

P18PCST101	**ADVANCED STRUCTURAL ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Structural Analysis I & II				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:- To impart knowledge on the analysis of indeterminate structures like continuous beams, trusses and portal frames.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To get introduced to matrix method of analysis.	An
CO2	To understand the different concepts of stiffness matrix method.	U
CO3	To know about the analysis of trusses.	An
CO4	To understand the concepts of boundary value problems.	U&An
CO5	To get knowledge about special analysis procedures.	Ap
CO6	To learn about the One Dimensional Equilibrium Problem.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	3	1	1		3	1	
	CO2	3	3		2	2	3	2	
	CO3		3	2		2	3	1	
	CO4	3	3	2	1	2	2	2	
	CO5		3	2		1	3	3	
	CO6	3	3	2	2	2	1	2	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION **9**

Introduction to matrix methods of analysis - statical indeterminacy and kinematical indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and torsional element. Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT II: STIFFNESS MATRIX METHOD **9**

Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - banded matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

UNIT III: FLEXIBILITY MATRIX METHOD **9**

Analysis of plane truss - continuous beams with and without settlement - plane frame including side sway grids, by flexibility methods and gables frames by System Approach.

UNIT IV: INTRODUCTION TO FEM **9**

Approximate Solution of Boundary Value Problems, Modified GalerkinMethod for One-Dimensional BVP, Matrix Formulation ofthe Modified GalerkinMethod.Shape Functions, Solution for Poisson's Equation, General OneDimensional Equilibrium Problem.

UNIT V: ADVANCED ANALYTICAL METHODS **9**

Special analysis procedures - static condensation and sub structuring - initial and thermal stresses. Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

REFERENCES:

1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Basic Structural Analysis by C.S.Reddy.
4. Matrix Structural Analysis by Madhu B. Kanchi.
5. Indeterminate Structural Analysis by K.U.Muthu et al.,I.K.International Publishng House Pvt. Ltd.
6. Matrix Methods of Structural Analysis by J.Meek.
7. Structural Analysis by Ghali and Neyveli.
8. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
9. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
10. The Finite Element Method, Desai and Able, CBS Publication.
11. https://lecturenotes.in/subject/972/advanced-structural-analysis-asa
12. http://www.nietodisha.com/btechlecturernote/ADVANCED%20STRUCTRURAL%20ANALYSIS.pdf
13. http://mech.iust.ac.ir/files/mech/madoliat_bcc09/pdf/yijun_liu___nummeth_20040121_fem.pdf

Course Coordinator **HOD**

P18PCST102	ADVANCED SOLID MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite course: Mechanics of Solids				
	Course Coordinator Name & Department: Mr.T.P.Meikandaan &Civil Engineering				

COURSE OBJECTIVES:- To educate the students in the area of two dimensional elasticity, concepts of torsion, plastic deformation and stress strain relations.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To get introduced to concepts of elasticity	U
CO2	To know the stress strain relations.	An
CO3	To know the concepts of two dimensional problems of elasticity.	E
CO4	To gain knowledge in concepts of torsions.	Ap
CO5	To learn the concepts of plastic deformation.	R
CO6	To learn the concept of Plane Stress and Plane Strain Problems	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	3		1		2	2	
	CO2	3	3		2	2	3	2	
	CO3		3	2		2	3	1	
	CO4	3	2	2	3	2	2	2	
	CO5		3	2		1	3	2	
	CO6		3	2	1	2	3	3	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION TO ELASTICITY **9**

Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.Strain and Stress Field - Elementary Concept of Strain, Stain at a Point, Principal Strains

and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic andDeviatoric Components.

UNIT II: EQUATIONS OF ELASTICITY **9**

Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axialityof the Principal Directions.

UNIT III: TWO-DIMENSIONAL PROBLEMS OF ELASTICITY **9**

Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

UNIT IV: TORSION OF PRISMATIC BAR **9**

Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar,Torsion of Thin Tubes.

UNIT V: PLASTIC DEFORMATION **9**

Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

REFERENCES:

1. Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
2. Elasticity,SaddM.H.,Elsevier,2005.
3. Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.
4. Computational Elasticity, AmeenM., Narosa,2005.
5. Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
6. Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.
7. L.S.Srinath,"Advanced Mechanics of Solids" Tata McGraw Hill, 2007.
8. A.R. Ragab, and S.E.Bayoumi,"Engineering Solid Mechanics: Fundamentals and Applications", CRC Press, 1999.
9. M.H.Sadd,"Elasticity: Theory,Applications and Numerics",Academic Press, 2006.
10. https://lecturenotes.in/subject/162/advanced-mechanics-of-solids-amos
11. https://nptel.ac.in/content/storage2/courses/105106049/pdf-assignments/main.pdf
12. https://www.rajagiritech.ac.in/Home/mech/Course_Content/Semester%20IV/ME%20202%20Advanced%20Mechanics%20of%20Solids/Module%206.pdf

Course Coordinator **HOD**

P18PRST101	**RESEARCH METHODOLOGY & IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**2**	**0**	**0**	**2**
	Prerequisite course: Project Management studies				
	Course CoordinatorName&Department :Dr.R.VenkataKrishnaiah&Civil Engineering				

COURSE OBJECTIVES:-

To learn about the investigation of solutions for research problem and necessary action

COURSE OUTCOMES (COs)	**Revised Blooms**

		Taxonomy
CO1	To learn about the investigation of solutions for research problem and necessary action.	U&Ap
CO2	To know about the Effective literature studies approaches	U
CO3	To learn about the Nature of Intellectual Property.	R
CO4	To study about the Patent Rights: Scope of Patent Rights	C
CO5	To know the New developments in IPR Patent information and databases. Geographical Indications.	Ap
CO6	To known more about the patents, Patenting under PCT	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		3			3	3
	CO2	1			2	3		2	3
	CO3		3	1	2			3	2
	CO4		3	1	2	3		3	3
	CO5	2	3		2			2	3
	CO6		3	1	2	2		1	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT 1: INTRODUCTION TO RESEARCH METHODOLOGY **9**

Meaning of research problem - Sources of research problem - Criteria Characteristics of a good research problem - Errors in selecting a research problem - Scope and objectives of research problem. Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations

UNIT II: RESEARCH SKILLS **9**

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT III: CONCEPTS OF PATENTS AND COPYRIGHT **9**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV: PATENT RIGHTS **9**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V: ADVANCEMENTS IN IPR **9**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall,"Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in NewTechnological Age", 2016.
9. John W. Creswell, "Research Design – Qualitative, Quantitative and Mixed Methods
10. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
11. KC Kankanala, AK Narasani & V Radhakrishnan, "Indian Patent Law and Practice", Oxford India Paperbacks, Edition, 2012.
12. https://iare.ac.in/sites/default/files/MTECH-CAD.CAM-R18-RM-IP-NOTES.pdf
13. http://www.uninova.pt/cam/teaching/SRMT/SRMTunit11.pdf
14. https://shodhganga.inflibnet.ac.in/bitstream/10603/55615/11/11_chapter%203.pdf

Course Coordinator **HOD**

P18PCST1L1	**STRUCTURAL DESIGN LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Computer Aided Design and Drawing Laboratory				
	Course Coordinator Name & Department: Ms.Arunya.A & Civil Engineering				

COURSE OBJECTIVES:-

To study the design and drawing of Structural Components of Frame Buildings using latest relevant IS codes

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn the analysis and drawing of RCC Framed structures	O
CO2	To study the analysis and drawing of plane and space truss.	O

CO3	To learn the analysis and drawing of water tank.	O
CO4	To study the analysis and drawing of Multi-Storey Frame Buildings.	P
CO5	To study the analysis and drawing of shell structure.	GR
CO6	To learn more about the Warren Truss.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		3		3	2	
	CO2	1	2		2	2	3	3	
	CO3		3	1	2		3	2	
	CO4		3	1	2	3	3	3	
	CO5	2	3		2		3	3	
	CO6		3	1	3	3	3	2	
3	Category	Professional Mathematics (PM)		**Professional Core (PC)**		Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

LIST OF EXPERIMENTS

1. Introduction to Staad. Pro V8i
2. Analysis of 3D Truss
3. Analysis and drawing of Truss 1 - Pratt Truss
4. Analysis and drawing of Truss 2 - Warren Truss
5. Analysis and drawing of RCC plane frames
6. Analysis and drawing of Space frame
7. Analysis and drawing of Multi-storey building
8. Analysis and drawing of Rectangular water tank
9. Analysis and drawing of Hemispherical shell

REFERENCES:

1. F.W.Beaufait et al., “Computer methods of Structural Analysis”, Prentice Hall, 1970
2. Structural Analysis, 3rd edition, R.C. Coates, M.G. Coutie, F.K. Kong, Van Nostrand Reinhold publishers.
3. file:///C:/Users/Hp/Downloads/technical_reference_v8i.pdf

4. https://www.academia.edu/11522766/STAAD.Pro_Fundamentals_STAAD.Pro_V8i_Bentley_Institute_Course_Guide
5. https://www.sefindia.org/forum/files/55837552_staad_pro_steps_122.pdf

Course Coordinator **HOD**

P18PCST1L2	**ADVANCED CONCRETE LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Concrete and Highway laboratory				
	Course Coordinator Name & Department: Mr.C.Anish & Civil Engineering				

COURSE OBJECTIVES:-

To provide exposure to the students with hands on experience in advanced structural engineering laboratory.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To provide hands on exercises in common concrete mix design by IS Code and other methods.	M
CO2	To expose the students regarding strain measurement using mechanical and electrical strain gauges.	GR
CO3	To provide hands on exercise flexural behavior of reinforced concrete beams.	COR
CO4	To provide exposure regarding structural behavior of columns.	P
CO5	To expose the students regarding non-destructive tests on concrete.	COR
CO6	To learn about the pre-tensioned and post-tensioned pre-stressed rectangular concrete beams.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		3		3	3	
	CO2	1	2		2	2	3	3	
	CO3		3	1	2		3	3	
	CO4		3	1	2	3	2	3	
	CO5	2	3		2		2	3	
	CO6		3	1	3	3	3	3	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS

1. Concrete mix design by IS Code and other methods.
2. Strain measurement using mechanical and electrical strain gauges.
3. Study on flexural behavior of reinforced concrete, pre-tensioned and post-tensioned pre-stressed rectangular concrete beams.
4. Study on structural behavior of columns
5. Non-destructive tests on concrete.

REFERENCES:

1. Krishna Raju N, (2000), "Design of concrete mixes", fourth edition CBS publishers, New Delhi.
2. IS:10262 – (2009), "Indian Standard recommended guidelines for concrete mix design", Bureau of Indian Standards, New Delhi.
3. SP: 23 – (1982), "Hand book of Concrete mixes", Bureau of Indian Standards, New Delhi.
4. Rajendra C, (2003), "Computer aided concrete Mix design", Allied publishers, New Delhi.
5. Krishna Raju N, (2003), "Design of reinforced Concrete Structures III Edition, CBS publishers, New Delhi.
6. Krishna Raju N, (1995), "Prestressed Concrete", III Edition, Tata McGraw Hill Publishing Co. New Delhi.
7. Lin T.Y., Burns N.H., (1982), "Design of Prestressed Concrete Structures", III Edition, John Woley and Sons, New York
8. https://theconstructor.org/concrete/concrete-mix-design-is10262-2009/13544/
9. https://www.iare.ac.in/sites/default/files/lab1/IARE_ACL_LAB_MANUAL.pdf
10. http://www.sginstitute.in/Downloads/Civil_Downloads/Manual_ConcreteTech.pdf
11. https://www.iare.ac.in/sites/default/files/lab1/IARE_ACL_LAB_MANUAL.pdf

Course Coordinator **HOD**

SEMESTER II

P18PCST201	**FEM IN STRUCTURAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Structural Analysis-I& II				
	Course Coordinator Name & Department: Ms.R.Chitra & Civil Engineering				

COURSE OBJECTIVES:-

To study the energy principles, finite element concept, stress analysis, meshing, linear problems and applications..

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn concepts of piecewise Approximation and Finite Elements	U
CO2	To know about two dimensional problems in stress analysis	An
CO3	To understand the meshing and solution problems.	E
CO4	To know about the nonlinear and vibration problems	An
CO5	To understand the Application to Thermal Analysis Problems.	An
CO6	To learn all the Finite Elements Procedures in Engineering analysis.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	3		1		3	3	
	CO2	3	3		2	2	3	2	
	CO3		3	3		2	2	2	
	CO4	3	2	2		2	1	2	
	CO5		2	2		1	1	2	
	CO6	1	3		2		3	1	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION **10**

Boundary Value problem – Approximate Solution - Variational and Weighted Residual Methods – Ritz and Galerkin Formulations – Concepts of piecewise Approximation and Finite Elements - Displacement and Shape Functions Weak formulation Minimum Potential Energy. Generation of Stiffness Matrix and Load Vector.

UNIT:II STRESS ANALYSIS **10**

Two dimensional problems – Plane Stress, Plane Strain and Axisymetric problems – Triangular and Quadrilateral Elements – Natural Coordinates –Isoparametric Formulation – Numerical Integration – Plate Bending and Shell Elements Brick elements for Fracture Analysis.

UNIT:III MESHING AND SOLUTION PROBLEMS **10**

Higher Order Elements – P & H methods of refinement – III conditional Elements – Discretisation Errors – Auto and Adaptive Mesh Generation Techniques – Error Evaluation.

UNIT:IV NONLINEAR AND VIBRATION PROBLEMS **10**

Material and Geometric Nonlinearity Methods of Treatment consistent System, Matrice Dynamic Condensation – Eigen Value Extraction.

UNIT V: THERMAL ANALYSIS **5**

Application to Thermal Analysis Problems.

REFERENCES:

1. Bathe, K.J. Finite Elements Procedures in Engineering analysis. Prentice Hall Inc., 1995.
2. Zienkicwicz, O.C. Arid Taylor, R.L. The Finite Elements Method, McGraw Hill, 1987.
3. Chandrupatla, R.T. and Belegunda. A.D, Introduction to Finite Elements in Engineering, 2nd Edition, Prentice Hall of India, 1997.
4. Moaveni.S.,Finite Element Analysis: Theory and Application with ANSYS, Prentice Hall Inc., 1999
5. Finite element analysis, theory and progarmming by GS Krishna Murthy
6. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu.
7. ntroduction to Finite element Method by JN Reddy.
8. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley &Sons
9. http://www.lu.fme.vutbr.cz/pistek/literatura/Megson%20-%20Structural%20And%20Stress%20Analysis.pdf
10. https://altairuniversity.com/wp-content/uploads/2014/02/meshing.pdf
11. https://nptel.ac.in/courses/105/105/105105041/
12. https://www.slideshare.net/hareeshang/modelling-and-analysis-laboratory-manual-vtu

Course Coordinator **HOD**

P18PCST202	**STRUCTURAL DYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite course: Basics of dynamics and asesmic design				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:-

To introduce the students about computer applications, structural analysis, design of special structures and expert systems with application analysis

COURSE OUTCOMES (COs)		Revised Blooms Taxonomy
CO1	To learn about Principles of dynamics and application to seismic instruments	R
CO2	To know about two and multiple degree freedom system	E
CO3	To understand about natural frequencies and modes shapes.	An
CO4	To know about the Computer applications and use of computer packages.	E
CO5	To analyze problems based on application to earthquake resistant design.	Ap
CO6	To learn more about design of special structures and expert systems with application analysis	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	3		1		2	1	
	CO2	3	3		2	1	3	3	
	CO3		3	2		2	2	2	
	CO4	3	2	2		2	3	2	
	CO5		2	2		1	2	3	
	CO6	1	3		1		3	1	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT-I :INTRODUTION **12**

Principles of Dynamics - D'Alambert'sPrinciple - formulation of equations of motion. Single Degree Freedom system - Free & Forced vibrations with and without damping Evaluation of Damping - Response of Single Degree Freedom system to Base Excitation - Transmissibility - Application to seismic instruments - Vibration isolation principle.

UNIT –II: TWO DEGREE OF FREEDOM **9**

Two Degree Freedom System - Application to Vibration Absorber - Multiple Degree Freedom System - Eigen value Problem - orthogonally &ortho normality properties of modes-Solution by Matrix Iteration - Mode superposition technique.

UNIT III: VIBRATION ANALYSIS **8**

Vibration of continuous system-Natural frequencies and modes shapes of uniform

beams-forced vibration response

UNIT IV: MACHINE FOUNDATION **8**

Application to Machine Foundation - Design of foundations for Steady State Mechanics - Principles of Dynamic Analysis IS2974 (pts I to V)

UNIT V: EARTHQUAKE RESISTANT SRTRUCTRES **8**

Application to Earthquake Resistant Design with particular Reference to Buildings Provisions of IS 1893

REFERENCES:

1. R. W. Clough &J. Penzien "Dynamics Of Structures" McGraw HILL, NY
2. Mario Paz "Structural Dynamics Theor:y And Computation", CBS Publishers, Delhi.
3. Srinivasulu P. &Vaidyanathan, C. V "Hand Book Of Machine Foundations" Tata McGraw Hill. New Delhi.
4. https://nptel.ac.in/courses/105/101/105101006/
5. https://lecturenotes.in/subject/522/structural-dynamics-sd
6. https://www.academia.edu/15013346/STRUCTURAL_DYNAMICS-GR_VTU_NOTES
7. https://www.slideshare.net/YashPatel408/two-degree-of-freddom-system
8. https://www.brown.edu/Departments/Engineering/Courses/En4/Notes/vibrations_mdof/vibrations_mdof.htm

Course Coordinator **HOD**

P18PCST2L1	**MODEL TESTING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Strength of materials lab				
	Course Coordinator Name & Department: Mr.k.Sathish Kumar & Civil Engineering				

COURSE OBJECTIVES:-

To provide exposure to the students with hands on experience in advanced structural engineering lab.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Understand the response of structures.	GR
CO2	Prepare the models.	S
CO3	Conduct model testing for static loading	M
CO4	Conduct model testing for free and forced vibrations	M
CO5	To provide hands on exercise on different testing equipments.	COR
CO6	To learn about the Characteristics of RC Beams using Piezoelectric Sensors	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3

2	CO1		3	1			2	3	
	CO2	1	2		2	1	3	3	
	CO3		3	3		3	2	3	
	CO4			3	3		3	3	
	CO5		2			2	2	2	
	CO6	3	1		2		1	3	
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

LIST OF EXPERIMENTS

1. Response of structures and its elements against extreme loading events.
2. Model Testing: Static - testing ofplates, shells, and framesmodels.
3. Model Testing: Free and forced vibrations, Evaluation of dynamic modulus.
4. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.

REFERENCES

1. Material Testing Laboratory Manual- Kishore K. & Ravi Chawla (Author), Kukreja C.B.
2. http://kssem.edu.in/civil-engineering-laboratories/
3. https://pdfs.semanticscholar.org/98b6/b666a3ae163c8d6d53ac66a39966dbe38ce0.pdf
4. https://www.brown.edu/Departments/Engineering/Courses/En4/Notes/vibrations_forced/vibrations_forced.htm

Course Coordinator **HOD**

P18PCST2L2	**NUMERICAL ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**2**	**2**
	Prerequisite course: Numerical Methods				
	Course Coordinator Name & Department: Ms.R.Chitra & Civil Engineering				

COURSE OBJECTIVES:-

To provide exposure to the students with hands on experience in advanced computing techniques.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Find Roots of non-linear equations by Bisection method and Newton's method.	GR
CO2	Do curve fitting by least square approximations.	GR

CO3	Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method.	GR
CO4	To Integrate Numerically Using Trapezoidal and Simpson's Rules	GR
CO5	To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- KuttaMethod.	M
CO6	To create the awareness and comprehensive knowledge in numerical solutions	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		3		3	3	
	CO2	1	2		2	3	3	2	
	CO3		3	1	2		3	1	
	CO4		3	1	2	3	3	3	
	CO5	2	3		2		3	2	
	CO6	2	1			2	2	3	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS:

1. Find the Roots of Non-Linear Equation Using Bisection Method. Find the Roots of Non-Linear Equation Using Newton's Method. Curve Fitting by Least Square Approximations.
2. Solve the System of Linear Equations Using Gauss - Elimination Method.
3. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method. Solve the System of Linear Equations Using Gauss - Jorden Method.
4. Integrate numerically using Trapezoidal Rule. Integrate numerically using Simpson's Rules.
5. Numerical Solution of Ordinary Differential Equations By Euler's Method.
6. Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

REFERENCES

1. Numerical methods for scientific and engineering computations. M.K.JainS.R.K.Iyengar – R.K.Jain Willey Eastern Limited.
2. Numerical methods by S.S.Shastry.
3. Applied numerical analysis by – Curtis I.Gerala- Addission Wasley – published campus
4. Numerical methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill book company.

5. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers, New Delhi
6. http://www.ycetnnl.edu.in/downloads/files/n532957dd8a753.pdf
7. http://gnindia.dronacharya.info/CSEIT/Downloads/Labmanuals/Lab_Manual_Numerical_Technique.pdf
8. https://people.clas.ufl.edu/kees/files/MAD4401PracticeProblems.pdf

Course Coordinator **HOD**

P18PRST201	**MINI PROJECT**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 4	**0**	**0**	**4**	**2**
	Prerequisite: B.E/B.Tech In Civil Engineering				
	Course Coordinator Name & Department: Ms.K.Anitha & 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 Blooms Taxonomy**
CO1	Identify structural engineering problems reviewing available literature.	P
CO2	Study different techniques used to analyze complex structural systems.	O
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	COR
CO4	To do pratical or case study experiments based on his /her projects.	S
CO5	To submit the project in a full form report	O
CO6	To build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3	2	1	2		3	1
	CO2	2	2		2	1		3	2
	CO3	2	3		1	2		3	2
	CO4		3	2	2	1		3	2
	CO5		2	1	1	3		3	3
	CO6		3		3	2		3	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Mini Project will have mid semester presentation 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**

SEMESTER III

P18PRST301	**DISSERTATION PHASE - I**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 20	**0**	**0**	**20**	**10**
	Prerequisite: Mini Project				
	Course Coordinator Name & Department: Mr. T.P. Meikandaan & 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 Blooms Taxonomy**
CO1	Identify structural engineering problems reviewing available literature.	P
CO2	Study different techniques used to analyze complex structural systems.	O
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	A
CO4	To do pratical or case study experiments based on his /her projects.	S
CO5	To submit the project in a full form report	COR
CO6	To build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	2		3
	CO2	2	2		2	1	3		2
	CO3	2	3		1	2	3		3
	CO4		3	2	2	1	2		2
	CO5		2	1	1	3	3		3
	CO6		3	3		2	3		3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation-I will have mid semester presentation 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 and must bring out individualscontribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

Course Coordinator **HOD**

SEMESTER IV

P18PRST401	**DISSERTATION PHASE - II**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 32	**0**	**0**	**32**	**16**
	Prerequisite: Dissertation Stage I				
	Course Coordinator Name & Department: Dr.S.J.Mohan & 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 Blooms Taxonomy**
CO1	Identify structural engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex structural systems.	M
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	P
CO4	To do pratical or case study experiments based on his /her projects.	GR
CO5	To submit the project in a full form report	S
CO6	To build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	3	2	1	2		3	3
	CO2	2	2		2	1		2	3
	CO3	2	3		1	2		2	2
	CO4	3	3	2	2	1		1	2
	CO5		2	1	1	3		1	3
	CO6	2	3	3		1		1	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper Seminar/ Internship (PR)**
4	Approval	Meeting of Academic Council, May 2018				

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc.There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Course Coordinator **HOD**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES (PE – I)

P18PEST011	**THEORY OF THIN PLATES AND SHELLS**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Theory of strutcures				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:-

The objective of the course is to undersand the analytical methods for complex structures.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Use analytical methods for the solution of thin plates and shells.	An
CO2	Use analytical methods for the solution of shells.	An
CO3	Apply the numerical techniques and tools for the complex problems in thin plates.	Ap
CO4	Apply the numerical techniques and tools for the complex problems in shells.	Ap
CO5	To learn the applications of shell structures.	U
CO6	To known more about Design and Construction of Concrete Shells	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3		3
	CO2	1	2	2	1	3	3		2
	CO3	3	3	1	2	1	3		2
	CO4	2	3	2	1	3	1		2
	CO5	2	2	1	2	2	2		2
	CO6	3	2	2	2	2	3		3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION **9**

Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equations of Equilibrium using Principle ofVirtual Work, Boundary Conditions.

UNIT II: STATIC ANALYSIS OF PLATES **9**

Governing Equation for a Rectangular Plate, NavierSolution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT III: CIRCULAR PLATES **9**

Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT IV: STATIC ANALYSIS OF SHELLS **9**

Membrane Theory ofShells - Cylindrical, Conical andSpherical Shells.

UNIT V: SHELL STRUCTURES **9**

Shells ofRevolution with BendingResistance - Cylindrical andConical Shells, Application to Pipes and Pressure Vessels.Thermal Stresses in Plate/ Shell

REFERENCES:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
2. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
3. Thin Elastic Shells, KrausH., John Wiley and Sons.
4. Theory of Plates, Chandrashekhara K., Universities Press.
5. Design and Construction of Concrete Shells, RamaswamyG
6. Analysis of plates by T.K.Varadan and K.Bhaskar , Narosa Publishing House, 1999.
7. “Stresses in Shells” by Flugge. Blaisdell Publishing Co, 1966
8. 3. Design and construction of concrete shell roofs by G.S.Ramaswamy, CBS Publishers& Distributors,1986.
9. https://sites.google.com/view/clhutxnvcy/theory-of-plates-and-shells-lecture-notes-pdf
10. https://pdfs.semanticscholar.org/98b6/b666a3ae163c8d6d53ac66a39966dbe38ce0.pdf
11. https://www.pdfdrive.com/thin-plates-and-shells-theory-analysis-and-numgeom-e12174367.html

Course Coordinator **HOD**

P18PEST012	**THEORY & APPLICAIONS OF CEMENT COMPOSITES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Construction Technology				
	Course Coordinator Name & Department: Mr. T.P. Meikandaan & Civil Engineering				

COURSE OBJECTIVES:-

To impart knowledge of theory and application of cement composities and their applications

COURSE OUTCOMES (COs)	**Revised Blooms Taxonomy**

CO1	Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete	C
CO2	To understand the strain- stress behaviour.	U
CO3	Classify the materials as per orthotropic and anisotropic behaviour.	Ap
CO4	Estimate strain constants using theories applicable to composite materials.	U
CO5	Analyse and design structural elements made of cement composites.	An
CO6	To learn more about New Concrete Materials	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3		
	CO2	1	2	2	1		3	2	
	CO3	3	3	1	2	1	2		
	CO4		3	2	1		2	2	
	CO5		2	1		2	3	1	
	CO6	2	3		3	1	1		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: INTRODUCTION **9**

Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT II: MECHANICAL BEHAVIOUR **9**

Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Contiguity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT III: CEMENT COMPOSITES **9**

Types of Cement Composites, Terminology, Constituent Materials andtheir Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

UNIT IV: MECHANICAL PROPERTIES OF CEMENT COMPOSITES **9**

BehaviorofFerrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT V: APPLICATION OF CEMENT COMPOSITES **9**

FRC and Ferrocement - Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON andFibre Reinforced Concrete.

REFERENCES:

1. Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
2. Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
3. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.
4. Isaac M. Daniel and OriIshai - Engineering Mechanics of Composite Materials**,** OxfordUniversity ,Press, Second Edition, New Delhi.
5. Roman Solecki and R Jay Conant – Advanced Mechanics of Materials, Oxford UniversityPress,New York, Special Edition for sale in India
6. Michael W. Hyer - Stress Analysis of Fiber-Reinforced Composite Materials,WCB/McGraw-Hill,Singapore.
7. http://www.issp.ac.ru/ebooks/books/open/Composites_and_Their_Applications.pdf
8. https://nptel.ac.in/courses/105/108/105108124/
9. https://www.slideshare.net/ManjunathKB11/engineered-cementitious-composite-bendable-concrete-112597278.

Course Coordinator **HOD**

P18PEST013	**THEORY OF STRUCTURAL STABILITY**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Theory of elasticity and plasticity				
	Course Coordinator Name & Department: Ms.K.Anitha & Civil Engineering				

COURSE OBJECTIVES:-

To study the concept of buckling and analysis of structural elements.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To know the fundamentals of probability	R
CO2	To learn the resistance parameters and loads	E
CO3	To analyze the reliability of structures	An
CO4	To know the application concept	Ap
CO5	To understand the risk decision problems	U
CO6	To learn more about Stability Analysis and Design of Structures	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	2	3	2	
	CO2	1	2	2	1		1	1	
	CO3	3	3	1	2	2	3	2	
	CO4	2	3	2	2		1	1	
	CO5	3	2	1		2	2	1	
	CO6	1	3		2	2	3	1	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT III TORSIONAL AND LATERAL BUCKlING 9

Torsional buckling – Combined Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9

Governing differential equation - Buckling of thin plates, various edge conditions -Analysis by equilibrium and energy approach – Finite difference method.

UNIT V INELASTIC BUCKLING 9

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behavior of plates.

REFERENCES:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.

3. Gambhir, “Stability Analysis and Design of Structures”, springer, New York, 2004.
4. Simitser.G.J and Hodges D.H, ”Fundamentals of Structural Stability”, Elsevier Ltd., 2006.
5. Timoshenko.S.P, and Gere.J.M, “Theory of Elastic Stability”, McGraw Hill Book Company, 1963.
6. S.P. Timoshenko and J.M. Gere (1961), Theory of Elastic Stability, McGraw-Hill. T.V. Galambos and A.E. Surovek (2008),
7. Structural Stability of Steel: Concepts and Applications for Structural Engineers , Wiley.
8. Stability Theory of Structures by Ashwini Kumar, Allied Publishers.
9. http://www.civil.northwestern.edu/people/bazant/PDFs/Papers/B2%20Stability%20of%20Structures.pdf
10. http://www.iqytechnicalcollege.com/Structures4LectureNotes.pdf
11. https://lecturenotes.in/m/20550-note-of-structural-stability-by-sunil-senthili

Course Coordinator **HOD**

P18PEST014	ENVIRONMENTAL ENGINEERING STRUCTURES	L	T	P	C
	Total Contact Hours/ week: 45	3	0	0	3
	Prerequisite: :Design and Drawing –I (Irrigation &Environmental)				
	Course Coordinator Name & Department: Dr.B.Saritha & Civil Engineering				

COURSE OBJECTIVES:-

To make them understand the fundamentals of Structural design and their application in Environmental Engineering

COURSE OUTCOMES (COs)		Revised Blooms Taxonomy
CO1	To make them understand the fundamentals of Structural design of Concrete, Prestressed Concrete, Steel and Castiron etc.,	U
CO2	To understand about the methods of analysis and design of water tanks a nd the types of cement roofing system	C
CO3	To understand in detail about the design of special purpose structures like underground reservoirs and swimming pools	An
CO4	To improve the knowledge on the repair and rehabilitation of structures andalso diagonising and identification of the cause and damage.	Ap
CO5	To know about the exposure on steel, lattice structures used in water and sewerage works.	Ap
CO6	To know more about Rectification and corrosion problems.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1		2	3
	CO2	1	2	2	1			3	3

	CO3	3	3	1	2	1		3	3
	CO4	2	3	2	1			2	2
	CO5	2	2	1		2		3	3
	CO6	3	2		3	1		2	2
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNITI: DESIGN OF PIPES **9**

Structural design of a) Concrete b) Prestressed Concrete c) Steel and d) Castiron piping mains, sewerage tanks design - anchorage for pipes - massive outfalls - structural design and laying - hydrodynamic considerations. Advances in the manufacture of pipes.

UNIT II: ANALYSIS AND DESIGN OF WATER TANKS **9**

Design of concrete roofing systems a) Cylindrical b) Spherical and c) Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete. IS Codes for the design of water retaining structures.Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks - Economic analysis - introduction to computer aided design and packages.

UNIT III: DESIGN OF SPECIAL PURPOSE STRUCTURES **9**

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations – Theoritical considerations - selection of materials of construction.

UNIT IV: REPAIR AND REHABILITATION OF STRUCTURES **9**

Diagonising the cause for damage, Identification of different types of structural and non structural cracks - Repair and rehabilitation methods for Masonry, Concrete and Steel Structures.

UNIT V: EXPOSURE ON DIFFERENT STRUCTURES **9**

Exposure to Steel, Lattice Structures used in Water and Sewerage Works – Rectification and corrosion problems.

REFERENCES:

1. Reinforced Concrete by P .Dayaratnam.
2. Prestressed Concrete by Krishna Raju, Tata McGraw-ill Publishing Co. 2nd Edition 1988.
3. Reinforced Concrete by N.C.Sinha&S.K.Roy - S.Chand and Co. 1985.
4. Hulse R., and Mosley, W.H., "Reinforced Concrete Design by Computer", Macmillan Education Ltd., 1986.

5. Ramaswamy, G.S., "Design and Construction of Concrete shell roofs", CBS Publishers, India, 1986.
6. Green, J.K. and Perkins, P.H., "Concrete liquid retaining structures", Applied Science Publishers, 1981.
7. https://www.vssut.ac.in/lecture_notes/lecture1424353637.pdf
8. http://ethesis.nitrkl.ac.in/108/1/10401010.pdf
9. https://learnengineering.in/ce6021-repair-and-rehabilitation-of-structures/
10. http://www.sasurieengg.com/e-course-material/CIVIL/IV-Year%20Sem%208/CE2071%20RRS.pdf
11. https://www.vidyarthiplus.com/vp/attachment.php?aid=23161
12. https://www.vssut.ac.in/lecture_notes/lecture1424715726.pdf

Course Coordinator **HOD**

PROFESSIONAL ELECTIVES – PE II

P18PEST021	**ANALYTICAL & NUMERICAL METHODS FOR STRUCTURAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: : Finite Element Method				
	Course Coordinator Name & Department: Ms.Rchitra & Civil Engineering				

COURSE OBJECTIVES:-

To study the concept of buckling and analysis of structural elements.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Solve ordinary and partial differential equations in structural mechanics using numerical methods.	E
CO2	To Write a program to solve a mathematical problem.	An
CO3	To know the Solution ofNonlinear Algebraic and Transcendental Equations	An
CO4	To learn about the Numerical Differentiation & Integration	An
CO5	To learn about the Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.	An
CO6	To understand about Computer Algorithms.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3		3
	CO2	1	2	2	1		3		
	CO3	3	3	1	2	1	3		3
	CO4		3	2	1		3		
	CO5		2	1		2	3		1
	CO6		1		2	3	3		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9

Laplace transform, Definitions, properties – Transform error function, Bessel's function, Dirac Delta function, Unit Step functions – Convolution theorem – Inverse Laplace Transform: Complex inversion formula – Solutions to partial differential equations: Heat equation, Wave equation.

UNIT II: FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9

Fourier transform: Definitions, properties – Transform of elementary functions, Dirac Delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation, Wave equation, Laplace and Poison's equations.

UNIT III : CALCULUS OF VARIATIONS 9

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variation problems with moving boundaries – Problems with constraints – Direct methods – Ritz and Kantorovich methods.

UNIT IV: NUMERICAL DIFFERENTIATION & INTEGRATION 9

Numerical differentiation & integration Solution ofOrdinary and Partial Differential Equations. Finite Difference scheme: Implicit & Explicit scheme.

UNIT V: COMPUTER ALGORITHMS 9

Computer Algorithms**:** Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

REFERENCES:

1. An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.
4. C Language and Numerical methods by C.Xavier – New Age International Publisher. Reprint March 2012 ISBN:978-81-224-1174-4.
5. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers.
6. Numerical Methods for Engineers StevanC.Chopra, Raymond P.Canal Mc. Graw Hill Book Company.
7. https://mycourses.aalto.fi/pluginfile.php/176826/mod_resource/content/2/NMSE-16-Lectures1.pdf
8. http://www-users.math.umn.edu/~broom010/doc/laplace.pdf
9. https://www.maths.tcd.ie/~pete/pde2/part_3.pdf
10. https://www.uio.no/studier/emner/matnat/math/MAT-INF1100/h08/kompendiet/diffint.pdf

Course Coordinator **HOD**

P18PEST022	**STRUCTURAL HEALTH MONITORING**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: : Finite Element Method				

	Course Coordinator Name & Department: Mr.Anish & Civil Engineering

COURSE OBJECTIVES:-

To study the concept of buckling and analysis of structural elements.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Diagnosis the distress in the structure understanding the causes and factors.	U
CO2	Assess the health of structure using static field methods.	R
CO3	Assessthe health of structure using dynamic field tests.	R
CO4	Suggest repairs and rehabilitation measures of the structure	Ap
CO5	To learn the repairs andrehabilitations of structures	Ap
CO6	To learn Health Monitoring of Structural Materials and Components Methods .	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1		2	3
	CO2	1	2	2	1			2	
	CO3	3	3	1	2	1		1	3
	CO4		3	2	1			1	
	CO5		2	1		2		2	3
	CO6		2	1	3			1	3

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: STRUCTURAL HEALTH MONITORING **9**

Concepts,Various Measures, Structural Safety in Alteration. Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT II: STRUCTURAL AUDIT **9**

Assessment ofHealth ofStructure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT III: STATIC FIELD TESTING **9**

Types ofStatic Tests, Simulation and Loading Methods, sensor systems and hardware requirements,Static Response Measurement.

UNIT IV: DYNAMIC FIELD TESTING **9**

Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT V: INTRODUCTION TO REPAIRS ANDREHABILITATIONS OFSTRUCTURES **9**

Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

REFERENCES:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.
5. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.
6. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.
7. Smart Materials and Structures, Gandhi and Thompson 6. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang
8. https://nptel.ac.in/courses/114/106/114106046/
9. https://www.slideshare.net/PRAVEENKUMARYADAV6/structural-health-monitoring-137367765
10. https://www.iitk.ac.in/ce/test/Static%20and%20Dynamic%20Tests_Dr%20K.K.%20bajpei.pdf

Course Coordinator **HOD**

P18PEST023	STRUCTURAL OPTIMIZATION	L	T	P	C
	Total Contact Hours/ week: 45	3	0	0	3
	Prerequisite: : Design of structural steel				
	Course Coordinator Name & Department: Ms.R.Chitra & Civil Engineering				

COURSE OBJECTIVES:-

To study the optimization methodologies applied to structural engineering

COURSE OUTCOMES (COs)		Revised Blooms Taxonomy
CO1	To know the basic concept in optimization of structures	R

CO2	To analyze programming methods for optimal design of structures	An
CO3	To study the plastic design of structures	An
CO4	To learn the optimization methods	C
CO5	To understand the optimization by structural theorems	R
CO6	To learn more about the Optimum Structural Design	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	1		2
	CO2	1	2	2	1		3		3
	CO3	3	3	1	2	1	3		1
	CO4		3	2	2		2		2
	CO5		2	1		2	1		1
	CO6		2	1	2	2	2		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I :INTRODUCTION **8**

Basic Concepts of minimum weight, minimum cost design. Objective function, constraints, classical methods.

UNIT II: OPTIMIZATION TECHNIQUES AND ALGORITHMS **10**

Linear Programming, Integer Programming, Quadratic programming Dynamic Programming and Geometric Programming, methods for Optimal design of structural elements.

UNIT III :COMPUTER SEARCH METHODS **10**

Linear Programming Methods for plastic design of frames. Computer search methods for univariate and multivariate Minimization.

UNIT-IV: OPTIMIZATION THEOREMS **8**

Non Linear optimization, one dimensional Minimization methods – Exhaustive Research Dichotomous Search and direct root methods.

UNIT-V: GAME THEORY **9**

Optimization by structural theorems. Maxwell, Mitchell and Hayman's Theorems for trusses and frames, fully stressed design with deflection constraints, optimality criterion methods.

REFERENCES:

1. Spunt, Optimum Structural Design, Civil Engineering engineering Mechanics Services, Prentice – Hall, New Jersey 1971.
2. S.S. Rao, Optimization Theory and Application, Wiley Eastern Limited, NewDelhi, 1977.
3. Uri Krisch, Optimum Structural Design, McGraw Hill Book Co. 1981.
4. Richard Bronson, Operations Research, Schaum's Outline Series, McGraw Hill Book Co. Singapore, 1983
5. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer,Springer.
6. Variational methods for Structural optimization, Cherkaev Andrej, Springer.
7. file:///C:/Users/Hp/Downloads/Syllabus%20Structural%20Optimization.pdf
8. http://calla.rnet.missouri.edu/cheng_courses/com/com_syllabus.pdf
9. file:///C:/Users/Hp/Downloads/Ahrari_grad.msu_0128D_15013_OBJ.pdf

Course Coordinator **HOD**

P18PEST024	**DISASTER RESISTANT STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Repair and Rehabilitation of structures				
	Course Coordinator Name & Department: Mr. T.P. Meikandaan & Civil Engineering				

COURSE OBJECTIVES:-

To know the various types of disasters caused by the natural and disaster prone areas in India

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To understand the behavior concept of structures	U
CO2	To have knowledge about response of the structure for various disasters	R
CO3	To understand detailing of structures	R
CO4	To know about various modern materials	Ap
CO5	To have idea about assessment of structures	Ap
CO6	To learn the Ground improvement techniques.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	3	2	1		2	3
	CO2		1	2	2	1		3	3
	CO3	2	3	3	2	2		2	3
	CO4	3		3	2	1		3	2

	CO5	1		3	1			1	2
	CO6	1	1	2	2	2		1	3
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: BEHAVIOUR OF LIFE- LINE STRUCTURES **9**

Philosophy for design to resist earthquake, cyclone and flood- National and International codes of practice. By laws of urban and semi- urban areas. Traditional and modern structures.

UNIT II: COMMUNITY STRUCTURES **9**

Response of dams, bridges, buildings- strengthening measures- safety analysis and rating- Reliability assessment.

UNIT III: REHABILITATION AND RETROFITTING **9**

Testing and evaluation- classification of structures for safety point of view- methods of strengthening for different disasters- qualification test.

UNIT IV: DETAILING OF STRUCTURES AND COMPONENTS **9**

Use of modern materials and their impact on disaster reduction- use of modern analysis, design and consruction techniques optimization for performance.

UNIT- V: DAMAGE ASSESSMENT OF STRUCTURES **9**

Damage surveys- Maintenance and modifications to improve hazard resistance- Different types of foundation and its impact on safety- Ground improvement techniques.

REFERENCES:

1. V. Moshrin ct. all concrete and Reinforced Concrete- Deterioration and Protection- Mir Publishers- Moscow 1980.
2. R.T. Alien and S.C. Edwards, Repair of Concrete Structures, Blakie and Sons. U.K. 1987.
3. Proceedings IABSE 14th Congress "Civilisation through Civil Engineering"- New Delhi, May 1992.
4. RaikerR.N.Learning from failures Deficiencies in Design, Construction and Service R&D Centre (SDCPL) RaikerBhavan, Bombay 1987.
5. http://www.vssut.ac.in/lecture_notes/lecture1424356121.pdf
6. http://www.ce.memphis.edu/7119/PDFs/FEAM_Notes/Topic07-ConceptsofEarthquakeEngineeringNotes.pdf
7. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RRS_Lecture_Notes_0.pdf
8. https://www.slideshare.net/binay2020/post-damage-assessment

Course Coordinator **HOD**

PROFESSIONAL ELECTIVES – PE III

P18PEST031	**ADVANCED STEEL DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Design of steel structures				
	Course Coordinator Name & Department: Mr.K.Sathish Kumar & Civil Engineering				

COURSE OBJECTIVES:-

To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing plastic analysis of structures and design of light gauge steel structures.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn design of members subjected to lateral loads and axial loads	U
CO2	To know about design of various types of Connections	R
CO3	To understand the analysis and design of steel towers.	An
CO4	To know about the plastic analysis of structures	E
CO5	To analyze and sole problems on design of light gauge steel structures.	An
CO6	To learn more concept in Design of foundations	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3	1	2
	CO2	1	1	2	1		3	2	
	CO3	3	2	1	2	1	3		1
	CO4		2	2	1		3	2	
	CO5		3	1	1	2	3	2	3
	CO6	2	3	2	1	1	3	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNITI: GENERAL **9**

Design of members subjected to lateral loads and axial loads. Analysis and design of Industrial buildings and bents – Sway and non-sway frames – Design of Purlins, Louver rails, Gable column and Gable wind girder – Analysis of Gable Frames – Check for deflection.

UNIT II: 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 III: ANALYSIS AND DESIGN OF STEEL TOWERS **9**

Analysis and design of Transmission Line Towers, Type of bracing patterns – Sag and Tension calculations – Design of self supporting chimney (lined and unlined) and guyed steel stacks – Stresses due to wind and earthquake forces – Design of foundations –Along wind loads - Calculation by Gust Factor Method.

UNIT IV: PLASTIC ANALYSIS OF STRUCTURES **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: DESIGN OF LIGHT GAUGE STEEL STRUCTURES **9**

Types of cross sections – local buckling and lateral buckling – Concepts of Effective width – Design of compression and tension members. Beams, Deflection of beams and design of beam webs. Combined stresses and connections.

REFERENCES:

1. Dayarathnam.P , Design of Steel Structures, A.H. Wheeler, 1990.
2. Design of Steel Structures – N. Subrhamanyan, Oxford
3. Steel Structure -Design and Behaviour, Salmon, C.G., and Johnson, J.E. Harper and Row,
4. Design of Steel Structure - Duggal, Tata Mc Graw Hill.
5. Home, M.R., and Monies, L.J, Plastic Design of Low-rise frames, Granada Publishing Ltd., 1981.
6. Salmo C.G., and Johnson J.E., Steel Structure- Design and Behaviour, harper and Row, 1980.
7. Kuzamanovic, B.O. and Williams, N., Steel Design for Structural Engineer, Prentice Hall, 1977.
8. Wie – Wen Yu., Cold – Formed Steel Structures, McGraw Hill Book Company, 1973.
9. William McGuire, Steel Structures, Prentice Hall, Inc., Englewood Cliffs, N.J. 1986.
10. https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf
11. https://lecturenotes.in/subject/545/advanced-structural-design-asd
12. https://nptel.ac.in/courses/105/106/105106113/

Course Coordinator **HOD**

P18PEST032	DESIGN OF FORMWORK	L	T	P	C
	Total Contact Hours/ week: 45	3	0	0	3

	Prerequisite: Reinforced Concrete Structures-I
	Course Coordinator Name & Department: Mr.K.Venkatraman & Civil Engineering

COURSE OBJECTIVES:-

To design, provision and maintenance of safe formwork plant and structures

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Select proper formwork, accessories and material	R
CO2	Design the form work for Beams, Slabs, columns, Walls and Foundations.	C
CO3	Design the form work for Special Structures.	C
CO4	Understand the working of flying formwork.	U
CO5	Judge the formwork failures through case studies.	Ap
CO6	To learn more about Formwork Management Issues –Pre- andPost-Award.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	1	2	
	CO2	1	1	2	L		3		
	CO3	3	3	1	2	1	3	1	
	CO4		3	2	1		1	2	
	CO5		2	1		2	1	1	
	CO6	2		3	1	2	2		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION **9**

Requirements andSelection of Formwork - Formwork Materials - Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.

UNIT II: FORMWORK DESIGN **9**

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab andBeams.

UNIT III: FORMWORK DESIGN FOR SPECIAL STRUCTURES **9**

Shells, Domes, Folded Plates, Overhead WaterTanks, Natural Draft Cooling Tower, Bridges.

UNIT IV: FLYING FORMWORK **9**

Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- andPost-Award.

UNIT V: FORMWORK FAILURES **9**

Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.

REFERENCES:

1. Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012. IS 14687: 1999.
3. False workfor Concrete Structures - Guidelines, BIS.
1. Jha, K.N., Formwork for Concrete Structures, First Edition, McGraw Hill. 2012
2. Tudor Dinescu and Constantin Radulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.
3. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGrawHill, 1996.
4. Michael P. Hurst, Construction Press, London and New York., 2003
5. Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996
6. http://www.egyankosh.ac.in/bitstream/123456789/28755/1/Unit-4.pdf
7. https://www.slideshare.net/sabnisajit/formwork-failures-and-remedial-measures
8. http://repository.sustech.edu/bitstream/handle/123456789/13278/chapter%202.pdf?sequence=3&isAllowed=y
9. http://www.cv.titech.ac.jp/~courses/atce2/Lesson1.pdf

Course Coordinator **HOD**

P18PEST033	DESIGN OF HIGH RISE STRUCTURES	L	T	P	C
	Total Contact Hours/ week: 45	3	0	0	3
	Prerequisite: Basic Dynamics and Aseismic design				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:-

To study the behavior, analysis and design of tall structures.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn about design criteria based on materials and sequential loading	U
CO2	To know about earthquake loading, model analysis and combinations of loading	An
CO3	To understand the behavior of various structural systems	An
CO4	To know about the Modeling for approximate analysis, Accurate analysis and redu techniques.	An

CO5	To understand special considerations in stability of tall buildings	Ap
CO6	To learn effect of foundation rotation.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3	1	
	CO2	1	2	2	1		3		
	CO3	3	3	2	2	1	2	2	
	CO4		3	2	1		3	1	
	CO5		2	1		2	2	1	
	CO6	2		3	1	2	1	2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: DESIGN CRITERIA **5**

Design philosophy - Loading, Sequential loading, materials – high performance concrete – Fiber reinforced Concrete – Light weight concrete – design mix.

UNIT II: LOADING AND MOVEMENT **5**

Gravity loading: Dead and live load.methods of live load reduction, Impact gravity loading, construction loads. Wind loading: Static and dynamic approach, Analytical and wind tunnel experimental method.

Earthquake loading: Equivalent lateral force, model analysis, combinations of loading, working stress design. Limit state design, plastic design.

UNIT III: BEHAVIOR OF VARIOUS STRUCTURAL SYSTEM **8**

Factors affecting growth, Height and Structural form. High rise behavior, Rigid frames, traced frames, Infilled frames, shear walls, coupled shear walls, wall – frames, tubulars, cores, futrigger-braced and hybrid mega systems.

UNIT IV: ANALYSIS AND DESIGN **20**

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem Interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis.

Structural elements: Sectional shapes, properties and resisting capacity,design, deflection, cracking, prestressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V: STABILITY OF TALL BUILDINGS **7**

Overall buckling analysis of frames, wall-frames. Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

REFERENCES:

1. Taranth B.S., Structural Analysis and Design of Tall Buildings, McGraw Hill, 1998.
2. Earthquake resistant Design for engineers & Architects: Dowrick D J
3. Dr. Y. P. Gupta, Editor, Proceedings National Seminar on High Rise Structures-Design and Construction practices for middle level cities Nov.14-16, 1995, New Age International Limited, Publishers, Madras-20.
4. Wolfgang Schueller, High Rise Buildings Structures, John wiley and Sons, 1977.
5. Bryan Stafford smith, Alexcoull, Tall Buildings Structures, Analysis and Design, John Wiley and Sons, Inc., 2005.
6. T. Y. Lin, Stores, Burry, Structural Concepts and systems for Architects and Engineers, John Wiley, 1988.
7. Lynn Beedle, Advance m Tall Buildings, CBS Publishers and Distributors, Delhi 1986.
8. http://www.byggmek.lth.se/fileadmin/byggnadsmekanik/publications/tvsm5000/web5213.pdf
9. https://www.slideshare.net/ce_arafat/basic-design-criteria-for-high-rise-buildings-62473145
10. https://www.slideshare.net/aaqibiqbal940/structural-systems-notes
11. http://faculty-legacy.arch.tamu.edu/anichols/index_files/courses/arch331/notes1.pdf
12. https://www.slideshare.net/aaqibiqbal940/advance-structure-system-notes-2

Course Coordinator **HOD**

P18PEST034	**DESIGN OF MASONARY STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Basic Structural Design				
	Course Coordinator Name & Department: Ms.A.Arunya & Civil Engineering				

COURSE OBJECTIVES:-

To learn about the bricks, stone masonary, constructions and design.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	Understand the masonry design approaches.	U
CO2	To analyse the Reinforced Masonry Members.	An
CO3	Determine interactions between members. Check the stability of walls.	E
CO4	Determine shear strength and ductility of Reinforced Masonry members	E
CO5	To understand the performance of elastic and Inelastic analysis of masonry walls.	U
CO6	To lunderstand the concept of use of Capacity Design Spectra.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	1	2	
	CO2	1	2	2	1		2	1	
	CO3	3	3	1	2	1	2	2	
	CO4		3	2	1		1	3	
	CO5		2	1		2	3	2	
	CO6	1		2	1	2	1	1	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: INTRODUCTION **8**

Historical Perspective, Masonry Materials, MasonryDesign Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations.

UNIT II: STRENGTH OF MASONARY MEMBERS **8**

Distribution ofLateral Forces.Flexural Strengthof Reinforced Masonry Members: In planeand Out-of-plane Loading.

UNIT III: FOUNDATION FOR MASONARY **8**

Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation. Shear Strength and Ductility of Reinforced Masonry Members.

UNIT IV: PRESTRESSED MASONRY **8**

Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

UNIT V: ELASTIC AND INELASTIC ANALYSIS **8**

Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.

REFERENCES:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings, Toma evi Miha, Imperial College Press, 1999
5. IS 1905-1987 Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.

6. SP 20 (S&T) – 1991, Hand book on masonry design and construction (1st revision) BIS, New Delhi.
7. https://nptel.ac.in/courses/105/106/105106197/
8. https://www.iitk.ac.in/nicee/IITK-GSDMA/EQ12b.pdf
9. https://ncma.org/resource/concrete-masonry-foundation-wall-details/

Course Coordinator **HOD**

PROFESSIONAL ELECTIVES – PE IV

P18PEST041	**DESIGN OF ADVANCED CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Reinforced Concrete Structures - I				
	Course Coordinator Name & Department: Ms.R.Chitra & Civil Engineering				

COURSE OBJECTIVES:-

To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn about calculation of deflection and crack width according to IS 456-2000	U
CO2	To know about design of special RC elements.	An
CO3	To Design flat slabs and flat plates according to ACI method.	An
CO4	To know about the inelastic behavior of concrete beams.	E
CO5	To analyze problems based on detailing for ductility.	An
CO6	To learn more about the Fire resistance of 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3	1	
	CO2	1	2	2	L		3	2	
	CO3	3	3	1	2	1	3	2	
	CO4		3	2	1		3	3	
	CO5		2	1		2	3	2	
	CO6	3	3	1	2	1	2	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: OVERALL REVIEW **9**

Review of limits state design of beams, Slabs and columns according to IS: 456-2000 Calculation of deflection and crack width according to IS 456-2000.

UNIT II: DESIGN OF SPECIAL RC ELEMENTS **11**

Design of Slender columns - Design of Rewalls - Ordinary and shear walls - Design of Corbels - Deep beams and grid floors.

UNIT III: FLAT SLABS AND FLAT PLATES **10**

Design of flat slabs and flat plates according to ACI method - Design of shear load - reinforcement and edge (Spandrel) beams - Yield line theory and Hillerberg method of design of slabs.

UNIT IV: INELASTIC BEHAVIOUR OF CONCRETE BEAMS **9**

In elastic behavior of concrete beams - moment - rotation curves - moment redistribution - Baker's method of plastic design, Design of cast in situ Joints in frames.

UNIT V: GENERAL **6**

Detailing for ductility - Fire resistance of buildings - field control of concrete.

REFERENCES:

1. Punmia B.C. ,Jain A.K., Limit State Design of Reinforced Concrete, Laxmi Publications pvt. Ltd.
2. Reinforced Concrete: Mechanics and Design, 6/E, James K. Wight, Pearson Prentice-Hall
3. Varghese P. C., Limit State Design of Reinforced Concrete, Prentic Hall of India, 1995.
4. Krishna Raju, N. Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 1986.
5. Varghese. P. C. Advanced Reinforced concrete design, Prentice Hall of India, 2005.
6. IS: 456 – 2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi
7. https://www.vssut.ac.in/lecture_notes/lecture1424715726.pdf
8. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m3l6.pdf

9. http://www.szt.bme.hu/phocadownload/english%20courses/reinforced%20concrete/2012/rclect10_12.pdf
10. https://nptel.ac.in/courses/105/105/105105105/

Course Coordinator **HOD**

P18PEST042	**ADVANCED DESIGN OF FOUNDATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite:Foundation Engineering				
	Course Coordinator Name & Department: Mr.P.Dayakar & Civil Engineering				

COURSE OBJECTIVES:-

To study the behavior of various material under impact and seismic loads and know the importance of design structures against earthquakes.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To learn about soil investigation and basic requirements of foundation	U
CO2	To know about types of pile foundations and structural design	R

CO3	To understand the types and design of well foundation.	C
CO4	To know about the design of foundation for reciprocating and impact machines	E
CO5	To understand process of special foundations on expansive soils.	Ap
CO6	To learn more about the Analysis and Design of substructures.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3	1	
	CO2	1	2	2	1		2	2	
	CO3	3	3	1	2	1	3	2	
	CO4		3	2	1		1	2	
	CO5		2	1		2	2	2	
	CO6	3	3	2	1	1	3	2	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: SHALLOW FOUNDATIONS **9**

Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation.

UNIT II : PILE FOUNDATIONS **9**

Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles – different shapes of piles cap – structural design of pile cap.

UNIT III : WELL FOUNDATION **9**

Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability.

UNIT IV : MACHINE FOUNDATIONS **9**

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for

Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.

UNIT V: SPECIAL FOUNDATIONS **9**

Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Design of anchors- Reinforced earth retailing walls.

REFERENCES:

1. Bowles .J.E., "Foundation Analysis and Design", McGraw Hill Publishing co., New York, 1986.
2. Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
3. Tomlinson.M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995.
4. Varghese.P.C, "Design of Reinforced Concrete Foundations" – PHI learning private limited, New Delhi – 2009.
5. Design of foundation system, N.P. Kurian, Narosa Publishing House.
6. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York.
7. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
8. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York.
9. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
10. https://nptel.ac.in/courses/105/105/105105039/
11. https://nptel.ac.in/courses/105/108/105108069/
12. https://nptel.ac.in/content/storage2/courses/105101083/download/lec31.pdf
13. http://gn.dronacharya.info/CivilDept/Downloads/question_papers/VIsem/AdvancedFoundationDesign/unit-5/Machine_Foundation.pdf

Course Coordinator **HOD**

P18PEST043	**SOIL STRUCTURE INTERACTION**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Soil Mechanics & Foundations Engineering				
	Course Coordinator Name & Department: Dr.R.Venkata Krishnaiah & Civil Engineering				

COURSE OBJECTIVES:-

Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions..

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To study soil response models of interaction analysis	U
CO2	To solve the infinite and finite beams on elastic foundations	An
CO3	To estimate the plate on elastic medium using ACI method	E

CO4	To analysis the pile and pile groups using design charts	C
CO5	To find the deflection on lateral loaded pile	An
CO6	To known more in Analysis of pile group	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1		2	3
	CO2	1	2	2	1				3
	CO3	3	3	1	2	1		3	3
	CO4		3	2	1			3	3
	CO5		2	1		2		2	3
	CO6	2		3	1	1			2
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: **SOIL RESPONSE MODELS OF INTERACTION ANALYSIS** **9**

Introduction to soil – Foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis, soil response models, Elastic continuum, Winkler, Two parameter elastic models, Elastic – plastic behavior, Time dependent behavior.

UNIT II: **INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATION** **9**

Infinite beam, General solution of the elastic line – concentrated and distributed loads on beams – Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads – General method.

UNIT III: **PLATE ON ELASTIC MEDIUM** **9**

Infinite plate, elastic continuum, Winkler, Two parameters, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, simple solution, ACI method, Analysis of highway and airfield pavements – solutions - General method.

UNIT IV: **ANALYSIS OF PILE AND PILE GROUPS** **12**

Elastic analysis of single pile – Solutions for settlement and load distribution – Simplified method for constructing load settlement curve to failure – Analysis of group settlement – Two pile interaction Analysis, Analysis of general groups – Theoretical solutions for free standing groups – Setttlement of groups caused by compressible underlying strata – Use of design charts –

Surface settlement around a group – Observed and predicted group behaviour.

UNIT V: LATERALLY LOADED PILE **6**

Load - deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Analysis of pile group, pile raft system, solutions through influence charts.

REFERENCES:

1. Salgado, R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 2006 3. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998.
3. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980. 5. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier 1979.
4. Kurien, N.P., "Design of Foundation Systems: Principles and Practices Narosa Publishing House, New Delhi, 1999.
5. Michael J Tomlinson, John C Woodward., Pile Design and Construction Practice, Sixth Edition, CRC Press, 2014
6. Edward Tsudik, "Analysis of Structures on Elastic Foundations", J. Ross Publishing, Cengage learning India Private limited, Delhi, 2013.
7. Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., New York, 1974.
8. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
9. Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17,
10. Elsevier Scientific Publishing Company.
11. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
12. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing.
13. https://theconstructor.org/structural-engg/soil-structure-interaction-effects-analysis-applications/17778/#:~:text=The%20study%20of%20soil%2Dstructure,a%20form%20of%20seismic%20excitation.&text=The%20structure,-The%20Foundation
14. https://www.nehrp.gov/pdf/nistgcr12-917-21.pdf

Course Coordinator **HOD**

P18PEST044	DESIGN OF INDUSTRIAL STRUCTURES	L	T	P	C
	Total Contact Hours/ week: 45	3	0	0	3
	Prerequisite: Design of steel structures				
	Course Coordinator Name & Department: Ms.R.Chitra & Civil Engineering				

COURSE OBJECTIVES:-

To understand the concepts of planning and functional requirements, roofs for industrial buildings in various structures and foundation designs

COURSE OUTCOMES (COs)		Revised Blooms Taxonomy
CO1	To learn about design of portal frames and different industrial structures.	U
CO2	To know the design concepts of steel bunkers and silos.	C
CO3	To understand the design of special purpose structures like chimneys and cooling towers.	E
CO4	To know about analysis and design of water tanks.	An
CO5	To design the power transmission structures.	C
CO6	To learn about the Planning and Design of Machine Foundations.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	3	1	3
	CO2	1	2	2	1		3		1
	CO3	3	3	1	2	1		1	3
	CO4		3	2	1		3	2	2
	CO5		2	1		2	2	3	
	CO6	3	3	2	1	2	1	2	2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INDUSTRIAL BUILDINGS **9**

Design of portal frame with hinge base - design of portal frame with fixed base - Gable Structures – Lightweight Structures. Roofs for Industrial Buildings - Steel and RC. Folded Plates and Shell Roofs - Gantry Girders - Design of Corbels and Nibs.

UNIT II: STEEL BUNKERS AND SILOS **9**

Bunkers and Silos, Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.

UNIT III: CHIMNEYS **9**

Chimneys - Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base

plate, design of foundation bolts, design of foundation. Cooling Towers - High Pressure boilers and piping design - Nuclear containment structures.

UNIT IV: WATER TANKS **9**

Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts – Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

UNIT V: POWER TRANSMISSION STRUCTURES **9**

Cables – Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers. Machine foundations - Planning and Design of Machine Foundations.

REFERENCES:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
3. Design of Steel Structures, Subramaniyam.
4. Procs. Of Advanced course on Industrial Structures, Structural Engineering Research Centre, 1982.
5. P Srinivasulu and C. V. Vaidyanathan. Handbook of Machine Foundations, Tata McGraw Hill 1976.
6. S.N. Manohar, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985.
7. AR. Santhakumar and S. S. Murthy, Transmission Line Structures, Tata McGraw Hill. 1992
8. https://www.vidyarthiplus.com/vp/Thread-ST7014-Industrial-Structures-Lecture-Notes-All-Units-Ashok-Edition
9. http://lacre.net/wp/types-of-industrial-properties-explained/779/
10. http://www.crectirupati.com/sites/default/files/lecture_notes/Electrical%20Power%20Transmission%20Systems%20-%20III-I%20EEE.pdf

Course Coordinator **HOD**

PROFESSIONAL ELECTIVES – PE V

P18PEST051	**DESIGN OF PRESTRESSED CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Reinforced Concrete Structures				
	Course Coordinator Name & Department: Ms.S.Thendral & Civil Engineering				

COURSE OBJECTIVES:-

Principle of pre - stressing, Analysis and design of pre - stressed concrete structures.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To know the principle of pre - stressing	U
CO2	To analyze the design of end block and circular pre - stressing	An
CO3	To know the design of compression members	R
CO4	To learn the design of composite beams and application	R
CO5	To understand the concept of pre - stressing in continuous beams	U
CO6	To learn the pre-stressed cylindrical shells, pre-stressed concrete poles.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	1	2	3
	CO2	1	2	2	1		2	1	
	CO3	3	3	1	2	1	1		2
	CO4	2	3	2	1		1	2	2
	CO5		2	1		2	1		1
	CO6	1	2	3	1			1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION **9**

Principles of Pre-stressing types and systems of pre-stressing, need for High Strength materials. Analysis methods losses, deflection (short-long term), camber, cable layout. Behavior under flexure – codal provisions (IS, British, ACI and DIN), ultimate strength.

UNIT II:END BLOCK & CIRCULAR PRESTRESSING **9**

Design of flexural members, Design for Shear, bond and torsion. Design of End blocks and their importance Design of tension members – application in the design of pre-stressed pipes and pre-stressed concrete cylindrical water tanks.

UNIT III:DESIGN OF COMPRESSION MEMBERS **9**

Design of compression members with and without flexure its application in the design pipes, flag masts and similar structures.

UNIT IV:COMPOSITE CONSTRUCTION **9**

Composite beams – analysis and design, ultimate strength – their applications. Partial pre-stressing – its advantages and applications.

UNIT-V CONTINUOUS BEAMS **9**

Application of pre-stressing in continuous beams, concept of linear transformation, concordant cable profile and cap cables. Special structures like pre-stressed folded plates, pre-stressed cylindrical shells, pre-stressed concrete poles.

REFERENCES

1. Pre-stressed Concrete by Krishna Raju, TataMcGraw Hill Publishing CO. 2nd Edition, 1988.
2. Fundamentals of Pre-stressed Concrete by N.C. Sinha & S.K. Roy S. Chand & Co., 1985.:
3. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons, Inc.1960.
4. Leonhardt. F., Prestressed Concrete, Design and Construction, Wilhelm Ernst and Shon, Berlin, 1964.
5. Freyssiner, Prestressed Concrete.
6. Military Engineers Hand Book.
7. Evans, R.H and Bennett, E.W. Prestressed Concrete, Champman and Hall, London, 1958.
8. IS: 1343- Code of Practice for Prestressed Concrete
9. IRC: 112
10. https://www.srividyaengg.ac.in/coursematerial/Civil/103723.pdf
11. https://www.vidyarthiplus.com/vp/attachment.php?aid=12962
12. https://www.egr.msu.edu/~harichan/classes/ce405/chap3.pdf
13. http://www.sasurieengg.com/e-course-material/CIVIL/IV-Year%20Sem%207/CE2404%20Pre%20stressed%20Concrete%20Structures.pdf
14. http://www.velhightech.com/Documents/CE6702-PSC-notes-wecompress.com_.pdf

Course Coordinator **HOD**

P18PEST052	**ANALYSIS OF LAMINATED COMPOSITE PLATES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Theory of structures				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:-

To present lamination theories and analysis of composite beams and plates**.**

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	To introduce types of composite materials and structures	R
CO2	Gain ability to model an elastic anisotropic composite body	U
CO3	Gain ability to estimate failure of laminate	U
CO4	Gain ability to analyze bending and buckling of composite laminates	An
CO5	To learn the FEM applicartions in laminates plates.	An
CO6	To learn the Formation of Stiffness Matrix using Computation method.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	3	1	2	3	1	
	CO2	1	2	3	1		3	2	
	CO3	3	3	1	2	2	1		
	CO4		3	2	2		3	2	
	CO5		2	1		2	2		
	CO6	3	1	3		1	2	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I: INTRODUCTION TO COMPOSITE MATERIALS **9**

Introduction to Composites – composite construction – properties of unidirectional long fiber composites – short fiber composites - Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, etc – Failure criterion.

UNIT II: PROPERTIES OF LAMINATES PLATES **9**

Elastic constants of composites – ply properties - Mechanical Behavior of Thin Laminated Plates - Damage of Composite Parts - Analysis of Laminates – Introduction - Theory of Laminated Beams and Laminates - Deflection and Buckling of Laminates - Bending of Thick Composite Plates.

UNIT III: LAMINATES ANALYSIS **9**

Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending ofRectangular Laminated Plates using CLPT.

UNIT IV: RESIDUAL STRESSES **9**

Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated PlatesUsing FSDT. Computation of Stresses - Analysis of Rectangular Composite Plates using Analytical Methods.

UNIT V: FEM APPLICATIONS **9**

Finite Element Solutions for Bending ofRectangular Laminated Plates using CLPT. Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses. Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C^0Element Formulation.

REFERENCES:

1. Analysis and Performance of Fiber Composites, Agarwal, B.D. and Broutman, L. J., John Wiley & Sons.
2. Mechanics of Composite Materials, Jones, R. M., Mc-Graw Hill
3. Structural Analysis of Laminated Comp , osites, Whitney, J. M., Technomic
4. Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.
5. https://link.springer.com/content/pdf/bfm%3A978-1-4020-8772-1%2F1.pdf
6. http://www.ae.iitkgp.ac.in/ebooks/chapter7.html
7. http://www.protoxrd.com/residual-stress-info.html

Course Coordinator **HOD**

P18PEST053	**FRACTURE MECHANICS OF CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Concrete Technology & Strength of Materials				
	Course Coordinator Name & Department: Ms.M.Hema priya & Civil Engineering				

COURSE OBJECTIVES:-

To impart knowledge on the mechanisms of failure and non linear fracture mechanics.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	The learner will be able to understand the behavior of concrete with tension and compression failure surfaces.	U
CO2	To learn the fracture mechanism process.	R
CO3	To know the concepts of failure analysis.	An
CO4	To understand the concepts of nonlinear fracture mechanics.	U
CO5	To learn the concepts of CTOD and CMD.	Ap

CO6	To learn the Fracture mechanics of concrete 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	2	1	1	1	2	
	CO2	1	2	2	1		2	1	
	CO3	3	3	1	2	1	3	2	
	CO4		3	2	1		2	2	
	CO5		2	1		2		3	
	CO6	2	1	2		2	1	1	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: INTRODUCTION TO FRACTURE MECHANICS **9**

Fundamentals of Fracture Mechanics, Mechanisms of fracture and crack growth.

UNIT II: FRACTURE MECHANISM **9**

Cleavage fracture, ductile fracture, fatigue cracking, Environment assisted cracking, Quasi brittle materials.

UNIT III: STRESS AT CRACK TIP **9**

Service failure analysis, linear elastic fracture mechanics, Griffith's criteria, stress intensity factors, crack tip plastic zone, Erwin's plastic zone correction, R curves, compliance, J Integral, nonlinear analysis ,Review of concrete behaviour in tension and compression, Basic frameworks for modeling of quasibrittle materials.

UNIT IV: NONLINEAR FRACTURE MECHANICS **9**

Nonlinear Fracture Mechanics – Discrete crack concept/Smeared crack concept, Size effect, Plasticity models for concrete – Associated and non-associated flow, Failure surfaces for quasibrittle materials.

UNIT V: MATERIAL MODELS **9**

Concept of CTOD and CMD, Material models, crack models, band models, models based on continuum damage mechanics.

REFERENCES:

1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Alphen aan den Rijn – Netherlands
2. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L. Elfgreen – Chapman and Hall – 1989.
3. Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
4. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.
5. Venkataraman and Patel "Structural Mechanics with introduction to Elasticity and Plasticity" – Mcgraw Hill, 1990. 6. Shanes – "Introduction to Solid Mechanics – II Edition, PH, 1989.
6. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
7. Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
8. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
9. https://www.researchgate.net/publication/329359959_Fracture_Mechanics_Lecture_notes
10. https://www.seas.harvard.edu/hutchinson/papers/353-5.pdf
11. https://oatao.univ-toulouse.fr/6634/1/Wellemane_6634.pdf

Course Coordinator **HOD**

P18PEST054	**DESIGN OF PLATES AND SHELLS**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week: 45	**3**	**0**	**0**	**3**
	Prerequisite: Theory of plasticity & Structural Analysis				
	Course Coordinator Name & Department: Dr.S.J.Mohan & Civil Engineering				

COURSE OBJECTIVES:-
To impart knowledge on the behavior and design of shells and Folded plates.

COURSE OUTCOMES (COs)		**Revised Blooms Taxonomy**
CO1	The learner will be able to analyse and design the shells and folded plates.	R
CO2	To learn the deflection of of uniformly loaded simply supported rectangular plate	U
CO3	To understand the concept of buckling of plates.	E
CO4	To know the concept of structural behaviour of shells	An
CO5	To learn the analysis of shells and Application to spherical shell	Ap
CO6	To known the Application to spherical shell and hyperboloid of revolution cooling towers.	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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	3	3	2	1	3	1	
	CO2		1	2	2	1	3	2	
	CO3	2	3	3	1	2	3	3	

	CO4			3	2	1	3	1	
	CO5	2		2	1		2	1	
	CO6	1	3		2	1	1	2	
3	Category	Professional Mathematics (PM)		Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	
4	Approval	Meeting of Academic Council, May 2018							

UNIT I: SMALL DEFLECTION THEORY OF THIN RECTANGULAR PLATES 9

Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.

UNIT II: PLATES ON ELASTIC FOUNDATIONS 9

Governing differential equation – deflection of uniformly loaded simply supported rectangular plate – Navier and Levy type solutions - Large plate loaded at equidistant points by concentrated forces.

UNIT III: BUCKLING OF PLATES 9

Governing equation for Bending of plate under the combined action of in-plane loading and lateral loads – Buckling of rectangular plates by compressive forces acting in one and two directions in the middle plane of plate

UNIT IV: INTRODUCTION TO SHELL STRUCTURES 9

Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation. Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT V: THE SHELLS OF DOUBLE CURVATURES 9

Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type. Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.

REFERENCES:

1. Design of concrete shell roofs By Billington – Tata MC Graw Hill, New York.
2. Shell Analysis By N.K.Bairagi. Khanna Publishers, New Delhi.
3. Theory of Plates and Shells by Timoshenko- Tata MC Graw Hill, College.
4. Analysis and design of concrete shell roofs By G.S.Ramaswami. CBS publications.
5. Design of concrete shell roofs By Chaterjee. Oxford and IBH. Wilhelm Flugge, stresses in shelts, Springer- Verlag.
6. Timoshenko, S. Theory of Plates and Shells, McGraw Hill, 1990

7. Ramasamy, G.S., Design and Construction of Concrete Shells Roofs, CBS publishers, 1986.
8. https://lecturenotes.in/download/note/31932-note-for-theory-of-plates-and-shells-ps-by-shaik-nida.
9. https://ocw.mit.edu/courses/mechanical-engineering/2-081j-plates-and-shells-spring-2007/readings/lecturenote.pdf
10. https://ttuir.tdl.org/bitstream/handle/2346/13151/31295005983639.pdf;jsessionid=A1C6F34A4DB85DF9E746D05F0343079F?sequence=1
11. https://www.ct.upt.ro/suscos/files/2016-2018/L16_17_Shell%20structures.pdf

Course Coordinator **HOD**

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.TECH – CONSTRUCTION ENGINEERING & MANAGEMENT
(FULL TIME) I – IV SEMESTERS

SEMESTER I							
S.No	**Category**	**Code No**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCCM101	Construction Equipment and Management	3	0	0	3
2	PC	P18PCCM102	Project Formulation and Appraisal	3	0	0	3
3	PE		Professional Elective I	3	0	0	3
4	PE		Program Elective II	3	0	0	3
5	PR	P18PRCM101	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCCM1L1	Concrete Structural Design Lab	0	0	2	2
7	PC	P18PCCM1L2	Advanced Concrete Lab	0	0	2	2
AUDIT COURSE							
8	AC	-	Audit Course 1	2	0	0	0
			Total	**16**	**0**	**4**	**18**

SEMESTER II							
S.No	**Category**	**Code No.**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCCM201	Advanced Construction Techniques	3	0	0	3
2	PC	P18PCCM202	Contract Laws and Regulations	3	0	0	3
3	PE		Professional Elective III	3	0	0	3
4	PE		Professional Elective IV	3	0	0	3
PRACTICAL							
5	PC	P18PCCM2L1	Model Testing Lab	0	0	2	2
6	PC	P18PCCM2L2	Project Management Lab	0	0	2	2
7	PR	P18PRMP201	Mini Project	0	0	4	2
AUDIT COURSE							
8	AC	-	Audit Course-2	2	0	0	0
			Total	**14**	**0**	**8**	**18**

SEMESTER III							
S.No	**Category**	**Code No.**	**Course Title**	**L**	**T**	**P**	**C**
1	PE		Professional Elective V	3	0	0	3
2	OE		Open Elective	3	0	0	3
3	PR	P18PRCM301	Dissertation Phase – I	0	0	20	10
			Total	**6**	**0**	**20**	**16**

SEMESTER IV							
S.No	**Category**	**Code No.**	**Course Name**	**L**	**T**	**P**	**C**
1	PR	P18PRCM401	Dissertation Phase – II	0	0	32	16
			Total	**0**	**0**	**32**	**16**

Total Credits for the programme = 18 + 18 +16 +16 = 68

LIST OF PROFESSIONAL ELECTIVES

Professional Elective (PE–I)

S.No	Code No.	Course Title	L	T	P	C
1	P18PECM011	Construction Project Management	3	0	0	3
2	P18PECM012	Construction Personnel Management	3	0	0	3
3	P18PECM013	Resource Management and Control in Construction	3	0	0	3
4	P18PECM014	Project Safety Management	3	0	0	3

Professional Elective (PE-II)

S.No	Code No.	Course Title	L	T	P	C
1	P18PECM021	Statistical Methods and Queuing Theory	3	0	0	3
2	P18PECM022	Advanced Concrete Technology	3	0	0	3
3	P18PECM023	Structural Health Monitoring	3	0	0	3
4	P18PECM024	Structural Optimization	3	0	0	3

Professional Elective (PE-III)

S.No	Code No.	Course Title	L	T	P	C
1	P18PECM031	System Integration in Construction	3	0	0	3
2	P18PECM032	Infrastructure Development	3	0	0	3
3	P18PECM033	Construction of Pavements	3	0	0	3
4	P18PECM034	Prefabrication and Construction Techniques	3	0	0	3

Professional Elective (PE- IV)

S.No	Code No.	Course Title	L	T	P	C
1	P18PECM041	Energy-Efficient Buildings	3	0	0	3
2	P18PECM042	Building Service	3	0	0	3
3	P18PECM043	Construction Economics & Finance	3	0	0	3
4	P18PECM044	Management Information Systems	3	0	0	3

Professional Elective (PE –V)

S.No	Code No.	Course Title	L	T	P	C
1	P18PECM051	Energy Conservation Techniques in Building Construction	3	0	0	3
2	P18PECM052	Condition Assessment and Evaluation Engineering	3	0	0	3
3	P18PECM053	Design of Industrial Structures	3	0	0	3
4	P18PECM054	GIS in Construction Engineering & Management	3	0	0	3

Open Elective (OE)

S.No	Code No.	Course Title	L	T	P	C
1	P18OECS001	Business Analytics	3	0	0	3
3	P18OEMA002	Operational Research	3	0	0	3
2	P18OEME003	Industrial Safety	3	0	0	3

4	P18OEBA004	Cost Management of Engineering Projects	3	0	0	3
5	P18OEME005	Composite Materials	3	0	0	3
6	P18OEEE006	Waste to Energy	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	3	0	0	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credits as per semester				No. of Credit	% of credit
		I	II	III	IV		
1	**Professional Mathamatics**	**3**	**-**	**-**	**-**	**3**	**4.4**
2	**Professional Core (PC)**	**6**	**6**	**-**	**-**	**12**	**17.6**
3	**Program Electives (PE)**	**3**	**6**	**3**	**-**	**12**	**17.6**
4	**Open Electives (OE)**	**2**	**-**	**3**	**-**	**5**	**7.4**
5	**Project Work, Seminar, Internship, Term Paper, etc. (PR)**	**4**	**6**	**10**	**16**	**36**	**33**
	Total Credits	**18**	**18**	**16**	**16**	**68**	**100**
	Total Contact Hours	**20**	**22**	**26**	**32**	**100**	

SYLLABUS
SEMESTER I

P18PCCM101	**CONSTRUCTION EQUIPMENT AND MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Construction Techniques Equipment and Practices				
	Course Coordinator Name & Department :Dr.S.J.Mohan,Civil Engineering				

COURSE OBJECTIVES: To introduce various construction equipment and study the efficient utilization of the same using scientific principles.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Manage the equipment, cost control and maintenance of a project.	Ap
CO2	Identify and understand the working principle of earthwork equipments.	U & R
CO3	Identify and understand the working of various equipments for different construction process.	U & Ap
CO4	Identify and understand the working principle of material handling equipments.	U & Ap
CO5	Understand the working of aggregate production and concreting equipments.	U & Ap
CO6	Identify and understand to the other new construction equipments.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	1		2		2		2
	CO2	3			1	2	1		
	CO3	3	1	3	1			2	2
	CO4	2	1						3
	CO5	3	2		2	1	3		1
	CO6	3	2	2	2			1	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-CONSTRUCTION EQUIPMENT MANAGEMENT **10**

Identification – Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment - Depreciation Analysis – Safety Management.

UNIT II-EQUIPMENT FOR EARTHWORK **10**

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers.

UNIT III-OTHER CONSTRUCTION EQUIPMENTS **10**

Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment – Equipment for Demolition.

UNIT IV-MATERIALS HANDLING EQUIPMENT **5**

Forklifts and related equipment - Portable Material Bins – Conveyors – Hauling Equipment.

UNIT V-EQUIPMENT FOR PRODUCTION OF AGGREGATE AND CONCRETING **10**

Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Hauling, Pouring and Pumping Equipment – Transporters.

REFERENCES:

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, 1988.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 1988.
4. Dr.MaheshVarma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi. 1983.
5. www.academia.edu_ Construction_Equipment_Management
6. www.sasurieengg.com › e-course-material › Construction_Equipment_Management
7. constructionem02.blogspot.com › construction-equipment-management.
8. https://nptel.ac.in/content/storage2/courses/105106149/week8/Week8_Lesson%208.%20Industry%20Perspective-Prof.%20N.%20Raghavan.pdf

Course Coordinator **HOD**

P18PCCM102	PROJECT FORMULATIONS AND APPRAISAL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Management Concepts for Civil Engineers				
	Course Coordinator Name & Department: Mr.C.Anish,Civil Engineering				

COURSE OBJECTIVES: To introduce and study formulation, costing, appraisal and finance of construction projects.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Formulate and generate the project and prepare reports for executing the work.	C
CO2	Understand the costing and cash flows of a project.	U & An
CO3	Assess various methods of project appraisal.	An
CO4	Understand the project financing and special schemes.	U & An
CO5	Know about private sector participation in Infrastructure Development Projects.	An & C
CO6	To know about Risk Analysis in Practice and Selection of a Project	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3	1		2		2		1
	CO2	3			1	2		3	
	CO3	3	1		1			3	2
	CO4	2	1				1		
	CO5	3	2		2	1		2	3
	CO6	3	2		2		3		

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-PROJECT FORMULATION **10**

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

UNIT II-PROJECT COSTING **10**

Project Cash Flows – Time Value of Money – Cost of Capital.

UNIT III-PROJECT APPRAISAL **15**

NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.

UNIT IV-PROJECT FINANCING **5**

Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios.

UNIT V-PRIVATE SECTOR PARTICIPATION **5**

Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

REFERENCES:

1. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review,Tata McGraw Hill Publishing Company Ltd., New Delhi. 2006.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992
3. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1987
4. egyankosh.ac.in › bitstream › project formulation.
5. https://www.scribd.com/document/170898967/Project-Formulation-and-Appraisal-pdf
6. www.academia.edu_ Construction_Equipment_Management
7. https://www.freebookcentre.net/business-books-download/Project-Management-by-NPTEL.html
8. constructionem02.blogspot.com › construction-equipment_project Appraisal.

Course Coordinator **HOD**

P18PCCM1L1	CONCRETE STRUCTURAL DESIGN LAB	L	T	P	C
	Total Contact Hours –30	0	0	2	2
	Prerequisite Course – Construction Engineering Laboratory				
	Course Coordinator Name & Department : Dr.S.J.Mohan,Civil Engineering				

COURSE OBJECTIVES: To expose the students to the testing of concrete under the action of various minerals and admixtures and determination of their characteristics experimentally and also to calculate mix design and perform NDT.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Know Design and Detail all the Structural Components of Buildings.	O
CO2	To Design and Detail all the Structural Components of Frame Buildings.	O
CO3	To Design and Detail complete Multi-Storey Frame Buildings.	O & P
CO4	To Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.	O & COR
CO5	To Know Design and Detail all the Structural Components of Buildings.	O
CO6	To Design and Detail all the Structural Components of Hemispherical shell	O & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3			1	2	2	1	
	CO2				1				3
	CO3	2	1	3	1		2	2	
	CO4		2			1	2		1
	CO5		1		1			1	2
	CO6	3	1		1	1	1		

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS

1. Introduction to Staad. Pro V8i
2. Analysis of 3D Truss
3. Analysis and drawing of Truss 1 - Pratt Truss

4. Analysis and drawing of Truss 2 - Warren Truss
5. Analysis and drawing of RCC plane frames
6. Analysis and drawing of Space frame
7. Analysis and drawing of Multi-storey building
8. Analysis and drawing of Rectangular water tank
9. Analysis and drawing of Hemispherical shell

REFERENCES:

1. W.H. & R.S. Mosely, J.H.Bungcy an R.Hulse, Reinforced Concrete Design, 5th Edition, Macmillan Co
2. Ramamrutham S, Design of Steel Structures, Dhanpat Rai Publishing *Co.*, New. Delhi, 2001
3. Dr.Purushothaman P Reinforced Concrete Structures Tata McGraw-Hill, 1984
4. Krishnamurthy D, Structural Design Drawing CBS Publication. New Delhi 1985.
5. https://www.iitk.ac.in/new/structural-engineering-laboratory
6. http://www.aust.edu/civil/lab_manual/ce_316.pdf
7. https://engineering.ksu.edu.sa/en/structural_materials_lab

Course Coordinator **HOD**

P18PCCM1L2	**ADVANCED CONCRETE LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	2	2
	Prerequisite Course – Construction Engineering Laboratory				
	Course Coordinator Name & Department : Mr.T.P.Meikandan,Civil Engineering				

COURSE OBJECTIVES: To expose the students to the testing of concrete under the action of various minerals and admixtures and determination of their characteristics experimentally and also to calculate mix design and perform NDT.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the Mix design of concrete as per IS, ACI & BS methods for high performance concrete.	M
CO2	Understand the Flow Characteristics of Self Compacting concrete.	COR
CO3	Know the Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.	GR
CO4	Perform NDT on hardened concrete.	M
CO5	Know the Permeability tests on hardened concrete.	A
CO6	To know the Rebound hammer and core tests on hardened concrete	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3			1	1	3		2

	CO2				1			1	1
	CO3	2	1		1			2	
	CO4		2				2		1
	CO5		1		1	1		3	
	CO6	3	2		1		2		1
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018							

LIST OF EXPERIMENTS

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self Compacting concrete
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability tests on hardened concrete

REFERENCES:

1. Sheety, M.S, Concrete Technology, Theory and Practice, S. Chand and Company Ltd, New Delhi, 2005.
2. Peurifoy R.L.,"Formwork for concrete structures", McGrew Hill Co., 1999
3. Jha J. and Sinha S.S., "Construction and Foundation Engineering", Khanna Publishers, 1993.
4. Chudley.R, "Construction Technology" (Vol. I, II, III,& IV) ELBS / Longman Publishers (second Edition)
5. Arora S.P and Bindra S.P. "Building Construction, Planning Techniques and Materials of Construction", Dhanpat Rai and sons 1997
6. https://www.iare.ac.in/?q=courses/mtech-structural-engineering/advanced-concrete-laboratory
7. http://kec.edu.np/wp-content/uploads/2017/06/Advanced-Concrete-Technology.pdf
8. https://www.serc.res.in/sites/default/files/CSIR-SERC-Lab-brochure-ACTEL.pdf
9. http://www.vnrvjiet.ac.in/civildept/ac.pdf

Course Coordinator **HOD**

SEMESTER II

P18PCCM201	**ADVANCED CONSTRUCTION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: – 45	3	0	0	3
	Prerequisite Course – Concrete Technology				
	Course Coordinator Name & Department: Mr.T.P.Meikandan,Civil Engineering				

COURSE OBJECTIVES: To bring about a complete understanding of advanced construction techniques in sub structure super structure and repair construction.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Understand the various processes involved in sub-structure construction.	U & An
CO2	Understand the various processes involved in super-structure construction.	U & An
CO3	Understand the construction process of special structures and offshore structures.	U & Ap
CO4	Know about the rehabilitation techniques carried out for a structure.	An & Ap
CO5	Know about the demolition techniques carried out for a structure.	Ap & E
CO6	To know about advanced construction techniques for offshore structures	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	3		1	1	1	3	
	CO2	2	3		1	1			1
	CO3	2	3			1	2		2
	CO4	2	3			1		1	
	CO5		1		1			3	3
	CO6	2	3		1	2	2		

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-SUB STRUCTURE CONSTRUCTION **15**

Box jacking - pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - piling techniques - driving well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - laying operations for built up offshore system - shoring for deep cutting - large reservoir construction - well points - dewatering and stand by plant equipment for underground open excavation.

UNIT II-SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS **10**

Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching techniques – suspended form work – erection techniques of tall structures, large span structures – launching techniques for heavy decks – insituprestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures.

UNIT III-CONSTRUCTION OF SPECIAL STRUCTURES **10**

Erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges – launching and pushing of box decks – Advanced construction techniques for offshore structures – construction sequence and methods in domes and prestress domes – support structure for heavy equipment and conveyor and machinery in heavy industries – erection of articulated structures, braced domes and space decks.

UNIT IV-REHABILITATION TECHNIQUES **6**

Mud jacking grout through slab foundation - micropiling for strengthening floor and shallow profile - pipeline laying - protecting sheet piles, screw anchors - sub grade water proofing, underpinning, crack stabilization techniques.

UNIT V-DEMOLITION **4**

Advanced techniques and sequence in demolition and dismantling.

REFERENCES:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
4. Peter.H.Emmons, “Concrete repair and maintenance illustrated”, GalgotiaPublicationsPvt. Ltd., 2001.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.
6. http://www.advancedconstructiontechniques.com/
7. https://2018.ctbuh.org/advanced-construction-techniques/
8. www.academia.edu.
9. http://www.sasurieengg.com/e-course-material/CIVIL/III-Year%20Sem%205/CE%206506%20Construction%20Techniques,%20Equipment%20and%20Practice.pdf

Course Coordinator **HOD**

P18PCCM202	CONTRACT LAWS AND REGULATIONS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Estimation and Costing				
	Course Coordinator Name & Department: Mr.C.Anish,Civil Engineering				

COURSE OBJECTIVES: To study contract laws and regulations so that adequate knowledge on formulating and managing construction contracts is gained.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the elements of concluding and the process of administering contracts.	An & C
CO2	Understand the various processes involved in tenders.	U & Ap
CO3	Achieve awareness on arbitrations and powers and duty of an arbitrator.	C
CO4	Know about the legal requirements and the corresponding government laws.	An
CO5	Know about the labour requirements and administration and the corresponding government laws.	An
CO6	To Evaluation of Tender from Technical Contractual and Commercial Points of View.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2			1	3		1
	CO2	3	1		1			1	
	CO3	2						2	1
	CO4	2			1	1	2		2
	CO5	2			1	1	1	2	
	CO6	2	3		2		1	1	1

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-CONSTRUCTION CONTRACTS **10**

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts

UNIT II-TENDERS **10**

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act.

UNIT III-ARBITRATION **5**

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs

UNIT IV-LEGAL REQUIREMENTS **10**

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations

UNIT V-LABOUR REGULATIONS **10**

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws

REFERENCES:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001
3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.
4. Kwaku, A., Tenah, P.E. Jose M.Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.
5. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.
6. https://www.vidyarthiplus.com/vp/Thread-GE2073-Contract-Laws-and-Regulations-Lecture-Notes
7. https://www.docsity.com/en/subjects/principles-of-contract/
8. https://www.academia.edu/20828922/B-LAW_NOTES_UNIT-1_-CONTRACT_ACT

Course Coordinator **HOD**

P18PCCM2L1	MODEL TESTING LAB	L	T	P	C
	Total Contact Hours – 30	0	0	2	2
	Prerequisite Course – Concrete Structural Design Lab				
	Course Coordinator Name & Department : Dr.S.J.Mohan,Civil Engineering				

COURSE OBJECTIVES: This course gives an exposure to test the models, frames and the behavior of model testing.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Response of structures and its elements against extreme loading events.	GR & S
CO2	To Know the Model Testing: Static - testing of plates, shells, and frames models.	M
CO3	To Know Model Testing: Free and forced vibrations, Evaluation of dynamic modulus.	M
CO4	To Know Beam vibrations, Vibration isolation, domain study.	COR
CO5	To understand the Vibration Characteristics of RC Beams using Piezoelectric Sensors.	COR
CO6	To know about Shear wall building model, Time and frequency-domain study.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3			1	1	2		1
	CO2				1			1	
	CO3	2	1		1		2		1
	CO4		2					2	
	CO5		1		1		3		2
	CO6	2		1	3	1		1	

3	Category	Professional Mathematics (PM)	**Professional Core (PC)**	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

LIST OF EXPERIMENTS

1. Response of structures and its elements against extreme loading events.
2. Model Testing: Static - testing of plates, shells, and frames models.
3. Model Testing: Free and forced vibrations, Evaluation of dynamic modulus.
4. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study.

REFERENCES:

1. Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.
2. https://www.iare.ac.in/?q=courses/mtech-structural-engineering/advanced-concrete-laboratory
3. https://www.serc.res.in/sites/default/files/CSIR-SERC-Lab-brochure-ACTEL.pdf
4. http://www.vnrvjiet.ac.in/civildept/ac.pdf

Course Coordinator **HOD**

P18PCCM2L2	**PROJECT MANAGEMENT LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours –30	0	0	2	2
	Prerequisite Course – Construction Engineering Laboratory				
	Course Coordinator Name & Department : Mr.Vinoth Kumar, Civil Engineering				

COURSE OBJECTIVES: This course gives an exposure to students in utilizing the sophisticated spread sheets programs, estimation software and other package programs and helps to gain knowledge about risk management.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Know Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project.	O
CO2	To Know the Design of a simple equipment information system for a construction project.	M
CO3	To Know the Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.	GR
CO4	To Know Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.	O
CO5	To understand the Simulation models for project risk analysis.	COR
CO6	To get knowledge on primavera montecarlo simulation.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3			1	1	1		1
	CO2	3			1	3		3	

	CO3				1		2		
	CO4	2	1		1	2		2	1
	CO5		2					1	
	CO6		1		1		2		1
3	Category	Professional Mathematics (PM)	**Professional Core (PC)**		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018							

LIST OF EXPRERIMENTS

1. Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project.
2. Design of a simple equipment information system for a construction project.
3. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
4. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.
5. Simulation models for project risk analysis.

LIST OF EQUIPMENTS/SOFTWARES/TOOLS REQUIREMENTS

1. Ms office
2. Qepro
3. Msoffice suit
4. Primavera power user
5. Primavera contractor standard
6. Pertmaster
7. Primavera montecarlo simulation
8. Primavera expedition

REFERENCES:

1. http://www.kau.edu.sa/GetFile.aspx?id=135046&fn=LAB_Manual_CPIS-334-Term1_2012-ver2_updated.docx.pdf
2. https://www.slideshare.net/sundasShabbir/software-project-management-lab-manual-lab-1

Course Coordinator **HOD**

P18PPRMP201	MINI PROJECT	L	T	P	C
	Total Contact Hours/ week – 4	0	0	4	2
	Prerequisite Course – B.E/B.Tech In Civil Engineering				
	Course Coordinator Name & Department :Dr.A.Mani,Civil Engineering				

COURSE OBJECTIVES: To provide exposure to the students to 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	Identify structural engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex structural systems.	P & COR
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	COR
CO4	To do practical or case study experiments based on his /her projects.	P & S
CO5	To submit the project in a full form report	GR
CO6	To prepare a research paper for publications in journal/conference proceedings.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	2	1	1
	CO2	2	2		2	1			
	CO3	2	3		1	2		2	3
	CO4		3	2	2	1	2	2	3
	CO5		2	1	1	3		1	2
	CO6		2	1	3	1	1		2

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/ Term Paper** Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

SYLLABUS CONTENTS:

Mini Project will have mid semester presentation 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 of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Course Coordinator **HOD**

SEMESTER III

P18PRCM301	**DISSERTATION STAGE I**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week– 20	**0**	**0**	**20**	**10**
	Prerequisite Course – Mini Project				
	Course Coordinator Name & Department : Dr.A.Mani,Civil Engineering				

COURSE OBJECTIVES: To provide exposure to the students to 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	Identify structural engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex structural systems.	P & COR
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	COR
CO4	To do practical or case study experiments based on his /her projects.	P & S
CO5	To submit the project in a full form report	GR
CO6	Choose latest tools, software and equipment to solve real world problems	P & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	3		1
	CO2	2	2		2	1		1	
	CO3	2	3		1	2	2		3
	CO4		3	2	2	1		1	3
	CO5		2	1	2	3	1		3
	CO6	2	3		1			2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	**Project/** Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

SYLLABUS CONTENTS:

Dissertation-I will have mid semester presentation 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 and must bring out individuals contribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

Course Coordinator **HOD**

SEMESTER IV

P18PRCM401	**DISSERTATION STAGE II**	**L**	**T**	**P**	**C**
	Total Contact Hours/ week– 32	**0**	**0**	**32**	**16**
	Prerequisite Course –Dissertation Stage I				
	Course Coordinator Name & Department : Dr.A.Mani,Civil Engineering				

COURSE OBJECTIVES: To provide exposure to the students to 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	Identify structural engineering problems reviewing available literature.	O
CO2	Study different techniques used to analyze complex structural systems.	P & COR
CO3	To work on the solutions given and present solution by using his/her technique applying engineering principles.	COR
CO4	To do practical or case study experiments based on his /her projects.	P & S
CO5	To submit the project in a full form report	GR
CO6	Choose latest tools, software and equipment to solve real world problems	P & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3	2	1	2	1	1	3
	CO2	2	2		2	1			3
	CO3	2	3		1	2	1	1	2
	CO4		3	2	2	1	3		
	CO5		2	1	1	3		2	1
	CO6		2	1	2	2	1		
3	Category	Professional Mathematics (PM)		Professional Core (PC)	Professional Elective (PE)		Open Elective (OE)		**Project/** Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018							

SYLLABUS CONTENTS:

Dissertation – II will be extension of the work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Course Coordinator **HOD**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE 1 (PE)

P18PECM011	**CONSTRUCTION PROJECT MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Construction Technology				
	Course Coordinator Name & Department : Mr.C.Anish,Civil Engineering				

COURSE OBJECTIVES: To study the elements of construction project management; consisting of owners' perspective, organization, design and construction procedures, resource utilization and cost estimation.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the types and financing of construction and changing environment of the industry.	Ap
CO2	Understand the organization of project management.	U & An
CO3	Know the design and construction process as an integrated system.	U & Ap
CO4	Know the labour, material and equipment utilization.	Ap
CO5	Understand Cost Estimates and the Costs Associated with Construction Facilities.	E
CO6	To know the Role of Project Managers and construction project management.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3			1	2	1	1	3
	CO2		2			1		2	
	CO3			1			2		1
	CO4		1			2		2	
	CO5	1			2				1
	CO6	2			2	3	1	1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-THE OWNERS' PERSPECTIVE **9**

Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers

UNIT II-ORGANIZING FOR PROJECT MANAGEMENT **9**

Project Management – modern trends - Strategic Planning - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer- Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team

UNIT III-DESIGN AND CONSTRUCTION PROCESS **9**

Design and Construction as an Integrated System - Innovation and Technological Feasibility - Innovation and Economic Feasibility - Design Methodology - Functional Design - Construction Site Environment

UNIT IV-LABOUR, MATERIAL AND EQUIPMENT UTILIZATION **9**

Historical Perspective - Labour Productivity - Factors Affecting Job-Site Productivity - Labour Relations in Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management. - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks

UNIT V-COST ESTIMATION **9**

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

REFERENCES:

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
3. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
4. Choudhury, S, Project Management, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. George J.Ritz , Total Construction Project Management - McGraw-Hill Inc, 1994.
6. www.academia.edu_ Construction_Equipment_Management
7. www.sasurieengg.com › e-course-material › Construction_Equipment_Management
8. constructionem02.blogspot.com › construction-equipment-management.
9. https://nptel.ac.in/content/storage2/courses/105106149/week8/Week8_Lesson%208.%20Industry%20Perspective-Prof.%20N.%20Raghavan.pdf

Course Coordinator **HOD**

P18PECM012	CONSTRUCTION PERSONNEL MANAGEMENT	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite: Course – Total Quality Management				
	Course Coordinator Name & Department: Mr.C.Anish,Civil Engineering				

COURSE OBJECTIVES: To introduce the elements of human behavior and their impact on construction personnel management.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know about the Manpower Planning and Organising.	An
CO2	Understand the Development and Operation of human resources	U & An
CO3	Understand the awareness on fundamentals of human behavior under varying stress conditions.	An
CO4	Know the welfare measures and Laws related to welfare measures.	An & Ap
CO5	Understand Management and Development Methods Productivity of Human resources.	An
CO6	Understand Job descriptions and organization structure and human relations.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		1		2		1
	CO2	2	1		1			1	
	CO3					2	2		1
	CO4	1				1		2	
	CO5	1					1		3
	CO6	3			1	2		1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-MANPOWER PLANNING **10**

Manpower Planning, Organising, Staffing, directing, and controlling – Personnel Principles

UNIT II-ORGANISATION **10**

Organisation – Span of Control – Organisation Charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection - Placement, Training and Development.

UNIT III-HUMAN BEHAVIOUR **10**

Introduction to the field of people management - basic individual psychology; motivation - ob design and performance management - Managing groups at work - self-managing work teams - intergroup behaviour and conflict in organisations – Leadership - Behavioural aspects of decision-making; and communication for people management

UNIT IV-WELFARE MEASURES **5**

Compensation – Safety and health – GPF – EPF – Group Insurance – Housing - Pension –Laws related to welfare measures.

UNIT V-MANAGEMENT AND DEVELOPMENT METHODS **10**

Compensation - Wages and Salary, Employee Benefits, employee appraisal and assessment - Employee services - Safety and Health – Discipline and discharge - Special Human resource problems, Performance appraisal. - Employee hand book and personnel manual – Job descriptions and organization structure and human relations – Productivity of Human resources.

REFERENCES:

1. Carleton Counter II and Jill Justice Coutler , The Complete Standard Handbook of Construction Personnel Management, Prentice-Hall, Inc., New Jersey, 1989.
2. Memoria,C.B., Personnel Management, Himalaya Publishing Co., 1997.
3. Josy.J. Familaro, Handbook of Human Resources Administration, McGraw- Hill International Edition, 1987.
4. Charles D Pringle, Justin GooderiLongenecter, Management, CE Merril Publishing Co.1981.
5. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillian IndiaLtd.,2005.
6. https://www.forconstructionpros.com/construction-technology/personnel-management
7. https://www.managementstudyguide.com/personnel-management.htm
8. www.academia.edu_ Construction_Management

Course Coordinator **HOD**

P18PECM013	**RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Building construction				
	Course Coordinator Name & Department: Mr.Vinoth Kumar, Civil Engineering				

COURSE OBJECTIVES: To study the resources required for construction like material, equipment, labour and time and comprehend the effective management of the same towards fruitful completion of the project.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the Resource Planning, Procurement and Identification.	U & An
CO2	Understand the Labour, Classes of Labour, and Cost of Labour.	An

CO3	Study and evaluate the resources - material, equipment, labour and time.	E
CO4	Know to manage time on the project and forecasting the future.	An
CO5	Understand other concepts regarding resource allocation and leveling.	U & Ap
CO6	Understand the Labour, Labour schedule, optimum use Labour.	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		2	1	3		2
	CO2	3	2		1	1		1	
	CO3	2		2	2		3		1
	CO4			2		1			
	CO5	3	2		1		1	1	1
	CO6	3	2		1	1		2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-RESOURCE PLANNING **10**

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

UNIT II-LABOUR MANAGEMENT **5**

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

UNIT III-MATERIALS AND EQUIPMENT **10**

Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

UNIT IV-TIME MANAGEMENT **10**

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects - Cash flow and cost control

UNIT V-RESOURCE ALLOCATION AND LEVELLING **10**

Time-cost trade off, Computer application - resource leveling, resource list, resource allocation, Resource loading, Cumulative cost - Value Management.

REFERENCES:

1. Andrew,D., Szilagg, Hand Book of Engineering Management, 1982.
2. James.A., Adrain, Quantitative Methods in Construction Management, American Elsevier Publishing Co., Inc., 1973.
3. Harvey, A., Levine, Project Management using Micro Computers, Obsorne- McGraw Hill C.A.Publishing Co., Inc. 1988.
4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1980.
5. https://www.researchgate.net/publication/284338543_Resource_Management_in_Construction_Projects_-_a_case_study
6. https://www.researchgate.net/publication/245282807_Resource_Management_inConstruction
7. https://esub.com/resources/construction-resource-management-solutions-and-concepts/

Course Coordinator **HOD**

P18PECM014	**PROJECT SAFETY MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course –Building construction				
	Course Coordinator Name & Department : Mr.C.Anish,Civil Engineering				

COURSE OBJECTIVES To study and understand the various safety concepts and requirements applied to construction projects and to study the nature of construction accidents, safety programmes, contractual obligations, and design for safety.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the nature of construction accidents and their causes.	An
CO2	Understand the Elements of an Effective Safety Programme.	U
CO3	Know the Safety in Construction Contracts, Substance Abuse and Safety Record keeping.	U & Ap
CO4	Know the Safety Culture and Project Coordination and Safety Procedures.	R & Ap
CO5	Understand other concepts regarding safety sampling and audit.	U & Ap
CO6	Know the Top Management Practices and Project Coordination Safety Procedures	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	3		1		1		2
	CO2		2			1		1	
	CO3	2	3		1		1		3
	CO4		2			1		1	
	CO5	2	3		1			2	1

	CO6	2	3		1		1	2	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT I-CONSTRUCTION ACCIDENTS **10**

Accidents and their Causes – Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications

UNIT II-SAFETY PROGRAMMES **10**

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives

UNIT III-CONTRACTUAL OBLIGATIONS **5**

Safety in Construction Contracts – Substance Abuse – Safety Record Keeping

UNIT IV-DESIGNING FOR SAFETY **10**

Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation

UNIT V-SAFETY SAMPLING AND AUDIT **10**

Safety sampling- safety audit - Components of safety audit – review of inspection critical incident technique- safety records, formats – implementation of audit indication check list – identification of unsafe acts of workers and unsafe conditions safety equipment - planning and site preparation- safety system of storing construction materials.

REFERENCES:

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
3. Tamilnadu Factory Act, Department of Inspectorate of factories, Tamil nadu.
4. https://safetymanagementgroup.com/contractor-safety-management-process-csmp/
5. https://www.ampmsafety.ie/construction-consultancy/project-safety-management/
6. https://www.oshatrain.org/pdf/constructionplan.pdf

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE II (PE – II)

P18PECM021	**STATISTICAL METHODS AND QUEUEING THEORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	0	0	3
	Prerequisite Course –Numerical Methods				
	Course Coordinator Name & Department : Ms.G.Subashini,				

COURSE OBJECTIVES: To develop analytical capability and to impart knowledge in statistical methods and Queuing theory and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Analyze the one dimensional random variable and their properties and functions.	An
CO2	Analyze and study about the estimation theory using various methods.	An & E
CO3	Analyze and test the hypotheses based on different distributions and attributes.	An & Ap
CO4	Analyze the variance and perform randomized block and latin square design.	An & C
CO5	Analyze and work on different queuing models.	An & C
CO6	To Understand and analysis Steady State Self Service queue.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3		2	1		1		1
	CO2	2		3		1		1	
	CO3	1	2			3		3	
	CO4	3		2	1		2		1
	CO5	1		2		3			3
	CO6	1		3	2		1	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-ONE DIMENSIONAL RANDOM VARIABLE **9+3**

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT II-ESTIMATION THEORY **9+3**

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT III-TESTING OF HYPOTHESES **9+3**

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, .2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT IV-DESIGN OF EXPERIMENTS **9+3**

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V-QUEUINGMODELS **9+3**

Poisson Process – Markovian queues – Single and Multi Server Models – Little's formula Machine Interference Model – Steady State analysis – Self Service queue.

REFERENCES:

1. Jay L. Devore, Probability and Statistics and Probability for Engineers, CENGAGE Learning, Indian Edition, Singapore, 2008.
2. D. C. Montgomery, G. C. Runger, Applied Statistics and Probability for Engineers, Third Edition, John Wiley and Sons, 2007.
3. D. Gross, C. M. Harris, Fundamentals of Queuing Theory, Third Edition, John Wiley and Sons, 2002.
4. Walpole, R.E., Myer, R.H., Myer, S.L. and Ye, K., Probability and Statistics forEngineers and Scientists, 7th edition, Pearson Education, Delhi, 2002.
5. Vohra, N.D. "Quantitative Techniques in Management", Tata McGraw – HillCompany Limited, 2007.
6. Gupta, S. C. and Kapoor, V. K., Fundamentals of Mathematical Statistics, SultanChand and Sons, New Delhi, 2001.
7. Taha, H. A., Operations Research: An Introduction, Seventh Edition, PearsonEducation Edition, Asia, New Delhi , 2002.
8. http://people.brunel.ac.uk/~mastjjb/jeb/or/queue.html
9. https://cs.wmich.edu/~alfuqaha/Fall07/cs6030/lectures/QueueingTheory-rev2.pdf
10. https://www.whitman.edu/Documents/Academics/Mathematics/berryrm.pdf

Course Coordinator **HOD**

P18PECM022	**ADVANCED CONCRETE TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Concrete Technology				
	Course Coordinator Name & Department: Mr.Vinoth Kumar, Civil Engineering				
COURSE OBJECTIVES: To study the properties of concrete, special types of concrete, concreting techniques and mix design procedure.					
COURSE OUTCOMES (COs):					**Revised Bloom's Taxonomy**

CO1	Know the concrete making materials.	U & Ap
CO2	Understand the properties of fresh and hardened concrete.	Ap
CO3	Know the Mix design adopted for casting of concrete.	C
CO4	Know the special types of concrete.	An
CO5	Understand the various concreting methods adopted.	U & An
CO6	Understand the underwater concrete special form work.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2		1		2	2	1
	CO2	1	2			3		1	
	CO3	2	2		1		3		3
	CO4	1	2						2
	CO5	2	2		1		1		1
	CO6	3	2		2			1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-CONCRETE MAKING MATERIALS **9**

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT II-CONCRETE **9**

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage, Variability of concrete strength, durability of concrete.

UNIT III-MIX DESIGN **9**

Principles of concrete mix design, Methods of concrete mix design, Testing of Concrete. Statistical quality control- sampling and acceptance criteria.

UNIT IV-SPECIAL CONCRETE **9**

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete, Super plasticised concrete, hyper plasticized concrete, Epoxy resins and screeds for rehabilitation - properties and applications - high performance concrete. High performance fiber reinforced concrete, self-compacting-concrete.

UNIT V-CONCRETING METHODS **9**

Process of manufacturing of concrete, methods of transportation, placing and curing. Extreme weather concreting, special concreting methods. Vacuum dewatering - T

REFERENCES:

1. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.
3. A.R.Santhakumar ;"Concrete Technology", Oxford University Press,2007.
4. Rudhani G. Light Weight Concrete Academic Kiado, Publishing Home of Hungarian Academy of Sciences, 1963.
5. http://www.ktuweb.com/page_showdoc?dopage=study&course=CE361&pgm=ECE&year
6. http://www.alphace.ac.in/downloads/notes/cv/10cv81.pdf
7. https://lecturenotes.in/m/17067-note-of-advance-concrete-technology-by-vijay-kumar

Course Coordinator **HOD**

P18PECM023	**STRUCTURAL HEALTH MONITORING**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course –Maintenance and Rehabilitation of structures				
	Course Coordinator Name & Department: Mr.Vinoth Kumar, Civil Engineering				

COURSE OBJECTIVES: Learn the fundamentals of structural health monitoring. Study the various vibration-based techniques for structural health monitoring. Structural health monitoring using fiber-optic and Piezoelectric sensors. Structural health monitoring using electrical resistance and electromagnetic techniques.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Understand the fundamentals of maintenance and repair strategies.	U&Ap
CO2	To Diagnose for serviceability and durability aspects of concrete.	R
CO3	To Know the materials and techniques used for repair of structures.	Ap
CO4	To Decide the appropriate repair, strengthening, for a case study building.	An
CO5	To Use an appropriate health monitoring technique and demolition technique.	R&Ap
CO6	To Understand the rehabilitation and retrofitting technique for repair of structures	U&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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2		1		1	1	3
	CO2		3			3		2	
	CO3	3				1	1		1
	CO4	1			2			1	
	CO5					1			1

	CO6	3	1	1	3		2	2	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT-I INTRODUCTION TO STRUCTURAL HEALTH MONITORING 9

Definition of structural health monitoring (SHM), Motivation for SHM, SHM as a way of making materials and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM, SHM as a part of system management, Passive and active SHM,NDE, SHM and NDECS, Variety and multidisciplinarity: the most remarkable characters of SHM, Birth of the SHM Community.

UNIT-II VIBRATION-BASED TECHNIQUES FOR SHM 9

Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State-space description of mechanical systems, Modeling of damaged structural elements, Linking experimental and analytical data, Modal Assurance Criterion (MAC) for mode pairing, Modal Scaling Factor (MSF), Co-ordinate Modal Assurance Criterion (COMAC), Damping, Expansion and reduction, Updating of the initial model, Damage localization and quantification, Change of the flexibility matrix, Change of the stiffness matrix, Strain-energy-based indicator methods and curvature modes, MECE error localization technique, Static displacement method, Inverse eigensensitivity method, Modal force residual method, Kinetic and strain energy-based sensitivity methods, Forced vibrations and frequency response functions, Solution of the equation system, Regularization, Parameter subset selection, Other solution methods, Variances of the parameters, Neural network approach to SHM, The basic idea of neural networks, Neural networks in damage detection, localization and quantification, Multi-layer Perceptron (MLP), A simulation example, Description of the structure, Application of damage indicator methods, Application of the modal force residual method and inverse eigensensitivity method, Application of the kinetic and modal strain energy methods, Application of the Multi-Layer Perceptron neural network, Time-domain damage detection methods for linear systems, Parity equation method, Kalman filters, AR and ARX models, Damage identification in non-linear systems, Extended Kalman filter, Localization of damage using filter banks, A simulation study on a beam with opening and closing crack, Applications, I-40 bridge,,Steelquake structure, Application of the Z24 bridge, Detection of delamination in a CFRP plate with stiffeners.

UNIT-III FIBER-OPTIC SENSORS 9

Classification of fiber-optic sensors, Intensity-based sensors, Phase-modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), The fiber Bragg grating as a strain and temperature sensor, Response of the FBG to uniaxial uniform strain fields, Sensitivity of the FBG to temperature, Response of the FBG to a non-uniform uniaxial strain field, Response of the FBG to transverse stresses, Photoelasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain and stress variations, Measurement of spectral perturbations associated with internal stress release resulting from damage spread, Examples of applications in

aeronautics and civil engineering, Stiffened panels with embedded fiber Bragg gratings, Concrete beam repair

UNIT-IV SHM WITH PIEZOELECTRIC SENSORS 9

The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, Available industrial AE systems, New concepts in acoustic emission, State-the-art and main trends in piezoelectric transducer-based acousto-ultrasonic SHM research, Lamb wave structure interrogation, Sensor technology, Tested structures (mainly metallic or composite parts), Acousto-ultrasonic signal and data reduction methods, The full implementation of SHM of localized damage with guided waves in composite materials, Available industrial acousto-ultrasonic systems with piezoelectric sensors, Electromechanical impedance, E/M impedance for defect detection in metallic and composite parts, The piezoelectric implant method applied to the evaluation and monitoring of viscoelastic properties.

UNIT-V SHM USING ELECTRICAL RESISTANCE 9

Composite damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, 0° unidirectional laminates, Multidirectional laminates, Randomly distributed fiber reinforced polymers, Damage localization. Low Frequency Electromagnetic Techniques Theoretical considerations on electromagnetic theory, Maxwell‘s equations, Dipole radiation, Surface impedance, Diffraction by a circular aperture, Eddy currents, Polarization of dielectrics, Applications to the NDE/NDT domain, Dielectric materials, Conductive materials, Hybrid method, Signal processing, Time-frequency transforms, The continuous wavelet transform, The discrete wavelet transform, Multiresolution, Denoising, Application to the SHM domain, General principles, Magnetic method, Electric method, Hybrid method.

REFERENCES:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley-ISTE, 2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.
3. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006.
4. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.
5. Smart Materials and Structures, Gandhi and Thompson
6. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang
7. http://www.iste.co.uk/data/doc_xqjujdlhnfls.pdf
8. https://www.aees.org.au/wp-content/uploads/2013/11/06-Wesson.pdf
9. https://www.hindawi.com/journals/ace/2010/724962/

Course Coordinator **HOD**

P18PECM024	**STRUCTURAL OPTIMIZATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course –Maintenance and Rehabilitation of Structures				
	Course Coordinator Name & Department: Dr.S.J.Mohan, Civil Engineering				
COURSE OBJECTIVES: To Learn the optimization techniques and linear optimization. Study the non-linear optimization and non-linear constrained optimization. Understand the dynamic programming, decision					

theory and simulations. Apply optimization techniques for simple structures.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	To Become confident at optimization techniques, linear optimization, algorithm, etc.	E
CO2	To Learn the nonlinear optimization-I and one dimensional minimization methods.	An
CO3	To Study the non-linear optimization-II by different methods.	R
CO4	To Use the optimization techniques for simple structures	An & Ap
CO5	To study about the structural optimization of Beams	E
CO6	To study about need and characteristics of dynamic programming and formulation	An & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2		1		2		1
	CO2		3			3		2	
	CO3	2				1			1
	CO4	1			2		2	1	
	CO5					1			3
	CO6	3	1		2		1	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT – I INTRODUCTION **9**

Introduction of optimization, basic theory and elements of optimization, Terminology and definitions, Basic principles and procedure of optimization. Classical Methods of Optimization: Trial and error method, Monte-Carlo method, Lagrangian multiplier method, illustrative examples Linear Programming: Introduction, terminology, formulation of LPP, graphical and algebric methods of solving LPP, standard form and canonical form of linear programming, geometrical intepretation, illustrative examples.

UNIT – II LINEAR PROGRAMMING **9**

Simplex methods, Artificial variable techniques, solution of simultaneous equations, Dual formulations - illustrative examples. Network analysis: Modifications and improvements on CPM/PERT Transportation and Assignment problem: Introduction, terminology, formulation and solution of mathematical models, illustrative examples.

UNIT – III NON-LINEAR PROGRAMMING **9**

local and global optimum, problem formulation, Unconstrained and constrained methods of optimization-Kuhn Tucker conditions, Lagrangian Multiplier methods, graphical method, Univariate search method, Steepest Descent Methods, quadratic programming problem, Wolfs modified simplex method, illustrative examples.

UNIT – IV DYNAMIC PROGRAMMING **9**

Introduction, terminology, need and characteristics of dynamic programming, formulation, solution of LPP, applications, illustrative examples Decision theory: Introduction, types, decision trees. Simulation : Introduction, advantages, limitations, types, applications.

UNIT – V STRUCTURAL OPTIMIZATION **9**

Optimum structural design of rectangular timber beam, reinforced concrete rectangular, T and L beams, concrete mix proportioning, reinforced concrete deep beams, planner trusses, Procedure of optimization for structural grid and slab.

REFERENCES

1. Engineering Optimization‖, S.S.Rao, New Age Internationals (1999).
2. Systems Analysis for Civil Engineers‖, Paul, J.O., john wiley & Sons (1988)
3. Fundamentals of Optimum Design in Engineering‖ S.S.Bhavikatti, New Age International
4. Publishers.
5. Operation Research‖, S.Kalavathy, Vikas Publishing house Pvt Ltd. Second edition
6. http://www.solid.lth.se/research/structural-optimization/
7. https://ocw.mit.edu/courses/architecture/4-491-form-finding-and-structural-optimization-gaudi-workshop-fall-2004/lecture-notes/
8. https://ascelibrary.org/doi/book/10.1061/9780784402207

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE III (PE – III)

P18PECM031	**SYSTEM INTEGRATION IN CONSTRUCTION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Maintenance and Rehabilitation of structures				
	Course Coordinator Name & Department : Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: To study and understand the construction system integration, environmental factors, services, and maintenance and safety systems.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know about the structural integration and systems	U & An
CO2	Understand the environmental factors and its relevant structural integration.	U & An
CO3	Know the services regarding plumbing and electricity.	Ap
CO4	Know the maintenance techniques and the materials involved.	Ap
CO5	Understand the safety and preventive systems.	An
CO6	To Understand the Planning systems for least maintenance materials and construction	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	2		1		2		
	CO2		3			3		1	2
	CO3	2				1		3	
	CO4	1			2			2	1
	CO5					1	1		
	CO6	3	1	1	2		3		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-STRUCTURAL INTEGRATION **9**

Structural System, Systems for enclosing Buildings, Functional aesthetic system, Materials Selection and Specification.

UNIT II-ENVIRONMENTAL FACTORS **9**

Qualities of enclosure necessary to maintain a specified level of interior environmental quality – weather resistance – Thermal infiltration – Acoustic Control – Transmission reduction – Air quality – illumination – Relevant systems integration with structural systems.

UNIT III-SERVICES **9**

Plumbing – Electricity – Vertical circulation and their interaction - HVAC

UNIT IV-MAINTENANCE **9**

Component longevity in terms of operation performance and resistance to deleterious forces - Planning systems for least maintenance materials and construction – access for maintenance – Feasibility for replacement of damaged components – equal life elemental design – maintenance free exposed and finished surfaces.

UNIT V-SAFETY **9**

Ability of systems to protect fire – Preventive systems – fire escape system design – Planning for pollution free construction environmental – Hazard free Construction execution.

REFERENCES:

1. William T. Mayer, Energy Economics and Building Design , McGraw-Hill Book Company, 1983.
2. Peter R. Smith and Warren G. Julian, Building Services, Applied Science Publishers Ltd., London, 1993.
3. A.J.Elder and MartizVindenBarg, Handbook of Building Enclosure, McGraw- Hill Book Company, 1983.
4. Jane Taylor and Gordin Cooke, The Fire Precautions Act in Practices, 1987.
5. David V.Chadderton, Building Services Engineering, Taylar and Francis, 2007.
6. https://pdfs.semanticscholar.org/76fc/7b29215670e68df21114bb5192f45a940585.pdf
7. https://www.irbnet.de/daten/iconda/CIB7409.pdf
8. https://www.amrita.edu/course/system-integration-construction
9. https://www.cmu.edu/cee/projects/PMbook/03_The_Design_And_Construction_Process.html

Course Coordinator **HOD**

P18PECM032	**INFRASTRUCTURE DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Building Construction				
	Course Coordinator Name & Department : Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: To bring about an understanding of the infrastructure development, status of infrastructure in India and the agencies associated with it.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the Role of infrastructure development in employment generation.	An
CO2	Know the Agencies associated with infrastructure development in India.	Ap
CO3	Know the status of Infrastructure in India.	An
CO4	Know the issues related to infrastructure development.	U & E
CO5	Understand the funding and managing of infrastructure projects.	U & Ap
CO6	Understand the role, responsibility of project management consultants.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2				1	1		
	CO2		1		2	1		3	1
	CO3				2	1			
	CO4				3	1		2	2
	CO5				2	1	3		
	CO6	3	2		1			1	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT I-INTRODUCTION **9**

Construction Industry – Nature, characteristics, size and structure - Role of infrastructure development in employment generation and improving of the National economy. Agencies associated with infrastructure development in India as regards various sectors.

UNIT II-SECTOR MANAGEMENT **9**

Agencies associated with infrastructure development in India as regards various sectors.

UNIT III-INFRASTRUCTURE PLANNING **9**

Status of Infrastructure in India- Indian government policy, Roads and buildings, communication, water supply, irrigation, power energy sectors, ports and aviation, health and educational services, rural development.

UNIT IV-PUBLIC AND PRIVATE SECTOR PARTNERSHIP **9**

Issues related to infrastructure development – pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in development.

UNIT V-FINANCING INFRASTRUCTURE PROJECTS **9**

Funding and managing infrastructure projects, role, and responsibility of project management consultants

REFERENCES

1. India Infrastructure Report – Rakesh Mohan
2. Infrastructure Today - Magazine
3. Document of five year plans, published by Govt. of India.
4. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

Course Coordinator **HO**

P18PECM033	CONSTRUCTION OF PAVEMENTS	L	T	P	C
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Transportation Engineering				
	Course Coordinator Name & Department: Dr.S.J.Mohan, Civil Engineering				

COURSE OBJECTIVES: To bring about an understanding of construction of pavements and the properties of pavements.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the materials in pavement construction.	An
CO2	Understand the design and properties of bituminous mixtures.	U & Ap
CO3	Know the properties of pavement quality and the construction practice.	Ap
CO4	Know the road making machineries.	Ap
CO5	Be aware of the latest advancements in pavement engineering.	An & C
CO6	To sampling and analysis concrete mixes design for pavement quality concrete.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2				1	2		1
	CO2		1		2	1		2	
	CO3				2	1			2
	CO4				3	1	2		
	CO5				2	1		1	3
	CO6	2	2		1		1	2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-ROAD MAKING MATERIALS FOR FLEXIBLE AND RIGID PAVEMENTS 9

Classification, testing and applications of road making aggregates – Road binders – Bitumen - Cement

UNIT II-PROPERTIES OF BITUMINOUS MIXTURES 10

Resistance of bituminous mixtures to permanent deformation – Flexibility and brittleness - Common mechanical tests – Permeability characteristics – Weathering of bituminous road surfacing – Adhesion of bituminous binders to road aggregates – Effect of aggregate size in bituminous courses – Temperature susceptibility of bituminous courses – Design of bituminous mixes.

UNIT III-PROPERTIESOF PAVEMENT QUALITY CONCRETE MIXTURES AND CONSTRUCTION PRACTICE 11

Properties of fresh and hardened concrete – laboratory tests – Design of concrete mixes for Pavement Quality Concrete. Construction of various layers in rigid and flexible pavements – Quality assurance during construction – sampling and analysis.

UNIT IV-MACHINERIES 8

Road making machineries – Road formation, bituminous constructions - Road surface evaluation

UNIT V-LATEST ADVANCEMENTS 7

Methods to improve bitumen quality – Rheological and chemical additives – Polymer modified bitumen – Super pave concepts – Recycling of bituminous courses – Smart materials for cement concrete pavement – Use of admixtures and fibres.

REFERENCES:

1. Mix Design Methods for Asphalt Concrete and other Hot mix types MS 2, Sixth Edition, The Asphalt Institute, 1997.
2. Edwin J.Barth, Asphalt Science and Technology, Gordon and Breach Science Publishers, New York, 1984.
3. Bituminous materials in road construction, The English Language Book Society and Her Majesty's Stationery Office, 1966.
4. http://www.alphace.ac.in/downloads/notes/cv/10cv763.pdf
5. https://www.civil.iitb.ac.in/tvm/1100_LnTse/401_lnTse/plain/plain.html
6. http://transportationengineering2012onwards.blogspot.com/2013/01/types-of-pavements-highway-engineering.html
7. https://www.nbmcw.com/roads-pavements/18259-types-of-pavements-used-in-road-construction.html

Course Coordinator **HOD**

P18PECM034	**PREFABRICATION AND CONSTRUCTION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Pre stressed concrete structures				
	Course Coordinator Name & Department: Dr.S.J.Mohan,Civil Engineering				

COURSE OBJECTIVES: To bring about an understanding of the prefabrication and construction techniques adopted.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the standardization and tolerances-system for prefabrication.	Ap
CO2	Understand the Pre-casting and handling techniques.	U & Ap
CO3	Know the Curing techniques including accelerated curing.	An
CO4	Know the Pre-cast and pre-fabricating technology for low cost and mass housing schemes.	Ap

CO5	Understand the Repairs and economical aspects on prefabrication.	U & E
CO6	Know the Planning, analysis and design considerations for prefabrication.	An & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		1		2		3		3
	CO2	2	1		1	1		1	
	CO3		2						3
	CO4	2	2			1	1		
	CO5	2			1			2	2
	CO6	3	3		1		1		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-INTRODUCTION **9**

Materials - Modular co-ordination, standardization and tolerances-system for prefabrication. Pre-cast concrete manufacturing techniques, Moulds –construction design, maintenance and repair.

UNIT II-PREFABRICATED TECHNIQUES **9**

Pre-casting techniques - Planning, analysis and design considerations - Handling techniques - Transportation Storage and erection of structures.

UNIT III-JOINTS IN STRUCTURAL MEMBERS **9**

Joints -Curing techniques including accelerated curing such as steam curing, hot air blowing etc., - Test on precast elements - skeletal and large panel constructions - Industrial structures.

UNIT IV-APPLICATIONS ON PREFABRICATION **9**

Pre-cast and pre-fabricating technology for low cost and mass housing schemes. Small pre-cast products like door frames, shutters, Ferro-cement in housing - Water tank service core unit.

UNIT V-QUALITY CONTROL **9**

Quality control - Repairs and economical aspects on prefabrication.

REFERENCES:

1. Levitt. M., Precast concrete - Materials, Manufacture Properties and Usage, Applied Science Publs. 1982,
2. Konex.T., Handbook of Pre-cast Construction, Vol.1.2&3.

3. Richardson,J.G., Pre-cast concrete Production, Cement and Concrete Association, London, 1973.
4. MadhavaRao.A-G., Modern Trends in Housing in Developing Countries, Oxford & UBH Publishing co., 1985. -
5. Lewicki.B., Building with Large Pre-fabrications, Elsevier Publishers.
6. Large Panel Prefabricated Constructions, Proc. of Advance Course conducted by SERC, Madras.
7. Bruggeling.A.S.G., &Huyghe.G.F., Prefabrication with Concrete, A.s.A., BalkemaPublishers, Netherland, 1991.
8. http://www.sasurieengg.com/e-course-material/CIVIL/IV
9. https://www.scribd.com/document/298958897/Prefabricated-Building-Construction-Notes
10. https://civildigital.com/prefabricated-structures-prefabrication-concept-components-advantages-ppt/

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE – IV (PE – IV)

P18PECM041	**ENERGY-EFFICIENT BUILDINGS**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Environmental studies				
	Course Coordinator Name & Department: Dr.R.Saritha, Civil Engineering				

COURSE OBJECTIVES: To study the design of energy efficient buildings which balances all aspects of energy, lighting, space conditioning and ventilation by providing a mix of passive solar design strategies and to learn the use of materials with low embodied energy.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the energy requirement of the building construction.	An
CO2	Understand the key design principles for energy efficient buildings	Ap
CO3	Know the concepts of day lighting and components of daylight factor.	U & Ap
CO4	Know the Heat transmission, heat control and ventilation.	E
CO5	Know about the Energy efficient buildings for various zones.	Ap
CO6	Understand the General Principles of Passive Cooling.	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		1		3	1	
	CO2		2		1	3			3
	CO3	2			2	2		1	
	CO4		1		1		2		1
	CO5	2	2					3	
	CO6	2	1		3		1		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-INTRODUCTION **9**

Energy required for building construction - Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Green house Effect – Psychrometry Chart – Measuring latent and sensible heat. Thermal Comfort – Site Planning and Development – Temperature –

Humidity – Wind – Optimum Site Locations – Sun Protection – Types of Shading Devices – Conservation – Heating and Cooling loads.

UNIT II-PASSIVE SOLAR HEATING AND COOLING 9

General Principles of passive Solar Heating – Key Design Elements -Direct gain – Trombe Walls, Water Walls, Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Predicting ventilation in buildings – window ventilation calculations - Radiation – Evaporation and dehumidification – Mass Effect – Load Control – Air Filtration and odor removal – Heat Recovery in large buildings.

UNIT III-DAY LIGHTING AND ELECTRICAL LIGHTING 9

Materials, components and details -Insulation – Optical materials – Radiant Barriers – Glazing materials -Daylighting – Sources and concepts – Building Design Strategies – Case Studies – Electric Lighting –Light Distribution – Electric Lighting control for daylighted buildings – Illumination requirement – Components of Daylight factor – Recommended Daylight factors – Daylighting analysis – Supplementary Artificial Lighting Design.

UNIT IV-HEAT CONTROL AND VENTILATION 9

Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation.

UNIT V-DESIGN FOR CLIMATIC ZONES 9

Energy efficiency – an overview of design concepts and architectural interventions – Energy efficient buildings for various zones – cold and cloudy – cold and sunny – composite – hot and dry – moderate – warm and humid – case studies of residences, office buildings and other buildings in each zones – Energy Audit – Certification.

REFERENCES:

1. Moore, F., Environmental Control System, McGraw Hill Inc. 2002
2. Brown, G.Z. and DeKay, M., Sun, Wind and Light – Architectural Design Strategies, John Wiley and Sons Inc, 2001
3. Chilogioji, M.H., and Oura, E.N., Energy Conservation in Commercial and Residential Buildings -Marcel Dekker Inc., New York and Basel, 1995.
4. Cook, J., Award-winning Passive Solar Designs, McGraw Hill Book Company, 1984
5. Dubin, F.S. and Long, C.G., Energy Conservation Standards – For Building Design, Construction and Operation - McGraw Hill Book Company 1990.
6. Majumdar, M. (Ed), Energy – efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
7. Tyagi, A. K.(Ed), Handbook on energy audits and management Tata Energy Research Institute, 2000.
8. https://energyeducation.ca/encyclopedia/Energy_efficient_building_design
9. https://www.intechopen.com/books/energy-efficient-buildings/energy-efficient-building-design-in-the-context-of-building-life-cycle
10. http://www.greeningtheblue.org/sites/default/files/energyefficiencyinbuildings_0.pdf

Course Coordinator **HOD**

P18PECM042	BUILDING SERVICES	L	T	P	C
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Building Construction				
	Course Coordinator Name & Department: Mr.Vinoth Kumar, Civil Engineering				

COURSE OBJECTIVES: To study the elements of building services like water supply sanitation, electrical installations air conditioning, and fire safety.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the components of water supply and sanitation arrangements in a building.	An
CO2	Understand the rudiments of electrical installations in a building.	Ap
CO3	Know the ventilation and design principles of lifts and staircases for vertical mobility inside buildings.	Ap
CO4	Know the safety regulations to be adopted in the building.	An
CO5	Know the concepts of intelligent building.	U & An
CO6	To Know the Green buildings and Energy efficient buildings for various zones.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	1	2		1		1	1	
	CO2		2		1	3			3
	CO3	2			2	2		2	
	CO4		1		1		3		
	CO5	2	2					2	1
	CO6	2	1		3		1		1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-WATER SUPPLY SYSTEMS **9**

Plumbing system for buildings-internal water supply in buildings-relevant municipal bye laws and regulations - Rain Water Harvesting -Sanitation in buildings-arrangement of sewerage systems in

housing – pipe systems- storm water drainage from buildings -septic tank – principles of collection, conveyance and disposal of town refuse.

UNIT II-WIRING SYSTEMS **9**

Types of wires , wiring systems and their choice –planning electrical wiring for building –main and distribution boards –transformers and switch gears –modern theory of light and colour –synthesis of light –luminous flux –candela- laws of illumination-lighting design-design for modern lighting.

UNIT III-VENTILATION AND VERTICAL MOBILITY **9**

Ventilation and its importance-natural and artificial systems-Window type and packaged air-conditioners-chilled water plant –fan coil systems-water piping –cooling load –air conditioning systems for different types of buildings –design principles of lifts and staircases for vertical mobility inside buildings.

UNIT IV-SAFETY REGULATIONS **9**

Causes of fire in buildings-safety regulations-NBC-planning considerations in buildings like Non-combustible materials, construction, staircases and electrical wiring and A.C. systems, special features required for physically handicapped and elderly in building types-heat and smoke detectors-dry and wet risers-Automatic sprinklers.

UNIT V-INTELLIGENT BUILDINGS **9**

Intelligent buildings-Building automation-Smart buildings- Building services in high rise buildings-Green buildings-Energy efficient buildings for various zones-Case studies of residence, office buildings and other buildings in each zones.

REFERENCES

1. G.M.Fair,J.C.Geyer and D.Okun, "Water and waste Engineering",Vol.II, John Wiley &sons,Inc.,New York. 2008.
2. R.G.Hopkinson and J.D.Kay,"The Lighting of buildings",Faber andFaber,London, 2009.
3. "Hand book for Building Engineers in Metric systems", NBC, NewDelhi, 2008..
4. "Philips Lighting in Architecture Designs",McGraw Hill, New York,2004.
5. "Time saver Standards for Architecture Design Data", CallendarJH,McGraw Hill, 2004.
6. William H.Severns and Julian R.Fellows, "Air conditioning and refrigeration", John Wily and sons, London,2008.
7. E.C. Butcher and A.C. Parnell, Designing for Fire Safety, John Wiley and Sons, 1993.
8. https://www.scribd.com/document/371867852/Building-Services-Introduction-Notes
9. https://lecturenotes.in/download/note/26367?utm_source=material-page&utm_medium=web&utm_campaign=download-page
10. https://www.designingbuildings.co.uk/wiki/Building_services
11. https://www.docsity.com/en/building-services-engineering/579980/

Course Coordinator **HOD**

P18PECM043	**CONSTRUCTION ECONOMICS & FINANCE**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Management Concepts for Civil Engineers				
	Course Coordinator Name & Department: Mr.K.Venkatraman, 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	Know about the engineering economics and Quality Audit in economic law of returns governing production.	U & Ap
CO2	Understand the Construction development in Housing, transport energy and other infrastructures.	U & Ap
CO3	Know the financial control and the need of financial management.	U & E
CO4	Know the Accounting for tax reporting purposes and financial reporting purposes.	U & E
CO5	Understand the interim construction financing.	E
CO6	Understand the lending to contractors	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		2			1	1		2
	CO2	2	1		1			2	
	CO3	2			2		2		
	CO4	1						1	1
	CO5		2		1		1		
	CO6		2	1		1		1	1

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-ECONOMICS **10**

Role of Civil Engineering in Industrial Development – Advances in Civil Engineering - Engineering Economics – Support Matters of Economy related to Engineering – Market demand and supply – Choice of Technology – Quality Audit in economic law of returns governing production.

UNIT II-CONSTRUCTION ECONOMICS **10**

Construction development in Housing, transport energy and other infrastructures – Economics of ecology, environment, energy resources – Local material selection – Form and functional designs – Construction workers – Urban Problems – Poverty – Migration – Unemployment – Pollution.

UNIT III-FINANCING **13**

The need for financial management - Types of financing – Financing instruments– short term borrowing – Long term borrowing – Leasing – Equity financing – Internal generation of funds – External commercial borrowings – Assistance from government budgeting support and international

finance corporations – Analysis of financial statements – Balance Sheet - Profit and Loss account – Cash flow and Fund flow analysis – Ratio analysis – Investment and financing decision – Financial Control - centralized management.

UNIT IV-ACCOUNTING METHOD **6**

General Overview – Cash basis of a accounting – Accrual basis of accounting –Percentage completion method – Completed contract method – Accounting for tax reporting purposes and financial reporting purposes – Accounting Standards.

UNIT V-LENDING TO CONTRACTORS **6**

Loans to Contractors – Interim construction financing – Security and risk aspects.

REFERENCES:

1. Prasanna Chandra, Project Selection, Planning, Analysis, Implementation and Review, Tata McGraw Hill Publishing Company, 1995.
2. Halpin, D.W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.
3. Warneer Z Hirsch, Urban Economics, Macmillan, New York, 1993.
4. Kwaku A, Tenah and Jose M.Guevara, Fundamental of Construction Management and Organisation, Prentice – Hall of India, 1995.
5. Madura, J and Veit, E.T., Introduction to Financial Management, West Publishing Co., St. Paul, 1988.
6. https://lecturenotes.in/m/29976-note-of-construction-economics-finance-by-md_shahjada_-alam
7. https://nptel.ac.in/courses/105/103/105103023/
8. https://lecturenotes.in/download/material/26182-construction-economic-and-finance

Course Coordinator **HOD**

P18PECM044	**MANAGEMENT INFORMATION SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Management Concepts for Civil Engineers				
	Course Coordinator Name & Department: Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: To study the various models of management information systems and their application to project management.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the exposure to information systems in a formal manner.	An
CO2	Understand the development of information systems.	Ap
CO3	Know the means of applying information systems models to project management.	Ap
CO4	Know to assess the value and risk of Information System.	C
CO5	Understand other concepts regarding system audit and its associated features.	Ap
CO6	Understand the Design, Production, Service, Software specification,	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	3				1	2		
	CO2	3	2		1			2	3
	CO3		1					1	
	CO4	1				2	1		2
	CO5	2	1		1			3	
	CO6		2			1	2	2	1
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
4	Approval	Meeting of Academic Council, May 2018							

UNIT I-INTRODUCTION **7**

Information Systems - Establishing the Framework - Business Models – Information System Architecture - Evolution of Information Systems.

UNIT II-SYSTEM DEVELOPMENT **8**

Modern Information System - System Development Life Cycle - Structured Methodologies - Designing Computer Based Methods, Procedures, Control - Designing Structured Programs.

UNIT III-INFORMATION SYSTEMS **10**

Integrated Construction Management Information System - Project Management Information System - Functional Areas, Finance, Marketing, Production, Personnel - Levels, DSS, EIS, and ES - Comparison, Concepts and Knowledge Representation - Managing International Information System.

UNIT IV-IMPLEMENTATION AND CONTROL **10**

Control - Testing Security - Coding Techniques - Defection of Error - Validating - Cost Benefit Analysis - Assessing the value and risk of Information System.

UNIT V-SYSTEM AUDIT **10**

Software Engineering qualities - Design, Production, Service, Software specification, Software Metrics, Software quality assurance - Systems Methodology - Objectives - Time and Logic, Knowledge and Human Dimension - Software life cycle models - Verification and Validation.

REFERENCES:

1. Kenneth C Laudon and Jane Price Laudon, Management Information Systems -Organisation and Technology, Prentice Hall, 1996.
2. Gordon B. Davis, Management Information System: Conceptual Foundations, Structureand Development, McGraw Hill, 1974.
3. Joyce J Elam, Case series for Management Information Systems , Simon and Schuster,Custom Publishing, 1996.
4. Ralph H Sprague and Huge J Watson, Decision Support for Managers, Prentice Hall, 1996.

5. Michael W. Evans and John J Marciniah, Software Quality assurance and Management, John Wiley and Sons, 1987.
6. Card and Glass, Measuring Software Design quality , Prentice Hall, 1990.
7. https://www.sigc.edu/department/mba/studymet/ManagmentInformationSystem.pdf
8. https://www.academia.edu/33858287/LECTURE_NOTES_on_Management_Information_Systems
9. https://www.slideshare.net/HarishChand5/management-information-system-full-notes

Course Coordinator **HOD**

PROFESSIONAL ELECTIVE V (PE – V)

P18PECM051	**ENERGY CONSERVATION TECHNIQUES IN BUILDING**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Repair and Rehabilitation of Structures				
	Course Coordinator Name & Department: Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: To bring about an exposure to different sources and production systems of energy and their effective management adopting appropriate design methodology in construction.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the energy production systems and energy economic analysis.	An
CO2	Understand the environmental aspect and resource conservation.	U & Ap
CO3	Know the energy efficient design strategies.	U & C
CO4	Know the energy audit, energy flow diagram and energy consumption.	U & C
CO5	Understand the concepts of energy management programme.	Ap
CO6	Know the Advanced building Technologies and Economies cost analysis.	An & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1		3		2		1	3	
	CO2				1	3			2
	CO3	3	3					2	1
	CO4		2		1				
	CO5	3		2			2		1
	CO6	3	2		1			1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-INTRODUCTION **6**

Fundamentals of energy- Energy Production Systems-Heating, Ventilating and air-conditioning – Solar Energy and Conservation – Energy Economic Analysis – Energy conservation and audits – Domestic energy consumption – savings - challenges – primary energy use in buildings - Residential – Commercial – Institutional and public buildings – Legal requirements for conservation of fuel and power in buildings.

UNIT II-ENVIRONMENTAL **7**

Energy and resource conservation – Design of green buildings – Evaluation tools for building energy – Embodied and operating energy – Peak demand – Comfort and Indoor Air quality – Visual and acoustical quality – Land, water and materials - Airborne emissions and waste management.

UNIT III-DESIGN **8**

Natural building design consideration – Energy efficient design strategies – Contextual factors – Longevity and process Assessment – Renewable Energy Sources and design – Advanced building Technologies – Smart buildings – Economies and cost analysis.

UNIT IV-SERVICES **12**

Energy in building design – Energy efficient and environment friendly building – Thermal phenomena – thermal comfort – Indoor Air quality – Climate, sun and Solar radiation, - Psychometrics – passive heating and cooling systems - Energy Analysis – Active HVAC systems - Preliminary Investigation – Goals and policies – Energy audit – Types of Energy audit – Analysis of results – Energy flow diagram – Energy consumption / Unit Production – Identification of wastage- Priority of conservative measures – Maintenance of energy management programme.

UNIT V-ENERGY MANAGEMENT **12**

Energy management of electrical equipment - Improvement of power factor – Management of maximum demand – Energy savings in pumps – Fans – Compressed air systems – Energy savings in Lighting systems – Air conditioning systems – Applications – Facility operation and maintenance – Facility modifications – Energy recovery dehumidifier – Waster heat recovery – Steam plants and distribution systems – Improvement of boiler efficiency – Frequency of blow down – Steam leakage – steam Flash and condense return.

REFERENCES:

1. Moore F., Environmental Control system McGraw Hill, Inc. 1994.
2. Brown, GZ, Sun, Wind and light: Architectural design strategies, John Wiley & Sons,1985.
3. Cook, J, Award – Winning passive Solar Design, McGraw Hill, 1984.
4. J.R. Waters, Energy conservation in Buildings: A Guide to part L of the Building Regulations, Blackwell Publishing, 2003.
5. https://tudresden.de/bu/bauingenieurwesen/cib/ressourcen/dateien/forschung/reeb/20100409_REEB_D532_Lecture_notes_CIB.pdf
6. https://www.slideshare.net/varunslide09/energy-conservation-provisions-in-building

Course Coordinator **HOD**

P18PECM052	CONDITION ASSESSMENT AND EVALUATION ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite Course – Repair and Rehabilitation of Structures				
	Course Coordinator Name & Department : Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: To bring about an understanding of use of methods, techniques and equipments for condition assessment and evaluation engineering.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the Procedure for the condition assessment of concrete structures.	An
CO2	Understand the working of NDT equipments.	E
CO3	Know the electro-chemical methods performed.	Ap
CO4	Know the chemical analysis for cement content.	Ap
CO5	Understand other concepts regarding performance and integrity tests.	E
CO6	Understand the condition assessment of structures and health monitoring.	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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		1		2	1	1
	CO2		2					3	
	CO3		2	2	1	2	1		1
	CO4		2		2			2	
	CO5		2			1			2
	CO6	1	1		2		1	1	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-CONDITION ASSESSMENT **9**

Introduction – Procedure for the condition assessment of concrete structures – walk over Survey – collation information – Establishment of in-service conditions – field visits – inspection – sampling – structural capacity –load testing – condition assessment of structures and health monitoring.

UNIT II-NON-DESTRUCTIVE TESTING **9**

Strength Tests - Rebound Hammer – Ultrasonic Pulse Velocity Measurement – Pull-out test – Pull-off test – Break-off test –Windsor Probe test –Core cutting.

UNIT III-ELECTRO-CHEMICAL METHODS **9**

Half–Cell Potential measurements - Resistivity – Permeability – Cover survey –tests for rebar corrosion assessment – Abrasion resistance test.

UNIT IV-CHEMICAL ANALYSIS **9**

Chemical analysis for cement content and type – Depth of carbonation –original water content – Chloride content –Sulphate content.

UNIT V-PERFORMANCE AND INTEGRITY TESTS **9**

Radiography –Radar – Resonant Frequency method-Acoustic Emission –Impact echo method – Dynamic Response.

REFERENCES:

1. Basheer, P. A. M., Proceedings of a Special Technical Session on ―Near-surface Testing for Strength and Durability of Concrete‖, Fifth CANMET/ACI International Conference on Durability of Concrete, Barcelona, Spain, 4-9 June 2000.
2. R.Holland., Appraisal & Repair of Reinforced Concrete, Thomas Telford
3. Michael Stratton, Structure and Style, E& FN Spon.
4. Recommendations for inspection, maintenance and management of Car Park structure-Institution of Civil Engineers – 2202, Typeset by Gray Publishers, Thomas Telford James Douglas, Building Adaptation, Elsevier.
5. Neville, A.M., Properties of Concrete, Pearson Education Asia (P) Ltd, England, 2000.
6. http://www.trb.org/mepdg/Part2_Chapter5_Evaluation.pdf
7. https://doi.org/10.6028/nbs.ir.80-2171
8. https://www.cfcrozier.ca/2018/06/08/what-is-a-building-condition-assessment/

Course Coordinator **HOD**

P18PECM053	**DESIGN OF INDUSTRIAL STRUCTURES**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Industrial Structures				
	Course Coordinator Name & Department: Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: To bring about an understanding of the design of Industrial structures and construction techniques for Industrial Structures

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the Specific requirements for industries.	An
CO2	Understand the Planning of building work of industrial structures.	An & Ap
CO3	Know the use of modern hoisting and other construction equipments.	An
CO4	Know the working of lifts, cranes, continuous conveyors.	E
CO5	Understand the Functional requirements of industrial structures.	An
CO6	Understand the other special constructions, cooling towers, chimneys; bunkers and silos.	U & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2	1		1	2	1		
	CO2		2					2	1
	CO3		2		1			3	
	CO4		2		2		1		1
	CO5		2			1		1	
	CO6	1	1		2		2		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
4	Approval	Meeting of Academic Council, May 2018							

UNIT I-GENERAL SPECIFICATIONS **9**

Specific requirements for industries, like textile, sugar, cement, chemical etc., site layout and external facilities.

UNIT II-POWER PLANT STRUCTURES **9**

Planning of building work-standards-structural materials including plastics, polymers, fibre glass, pressed cardboards, etc., multi-storey buildings; steel skeletal structures, reinforced concrete frames; workshops; ware houses; single storey buildings; sheds in steel and reinforced concrete; north lights; single span spherical and other special constructions; cooling towers and chimneys; bunkers and silos; prefabrication; construction.

UNIT III-FOUNDATION **9**

Construction Techniques-Expansion joints-machine foundations; water proofing; roofs and roofing; roof drainage; floors and flooring joists; curtain walling; outer wall facing; sound and shock proof mountings; use of modern hoisting and other construction equipments.

UNIT IV-INDUSTRIAL BUILDINGS **9**

Circulation, communication and transport; fixed points (central cores); stair cases; grid floor sections; lifts; cranes; continuous conveyors; mobile cranes; transporters; doors; sliding gates

UNIT V-PLANNING AND FUNCTIONAL REQUIREMENTS **9**

Functional requirements- Lighting: natural lighting; protection from the sun-sky lights; window cleaning installations. Services: layout; wiring; fixtures, cable and pipe bridges; electrical installations; lighting substation; effluent. Ventilation and fire protection: ventilation; air conditioning; fire escapes and chutes; fire alarms; extinguishers and hydrants.

REFERENCES

1. Dunham, C.W ,Planning of industrial structures-McGraw Hill book Co. 1948.

2. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2008.
3. Dayaratnam, P, Design of Steel Structures- Chand & Co, New Delhi, 2008.
4. SP32-1986, Handbook on Functional requirements of industrial buildings, BIS,New Delhi
5. https://www.vidyarthiplus.com/vp/Thread-ST7014-Industrial-Structures-Lecture-Notes-All-Units-Ashok-Edition
6. https://www.scribd.com/document/394284006/is-unit-2-Industrial-Structures-notes
7. https://technicalcivil.com/design-of-industrial-building-notes-pdf/
8. https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf

Course Coordinator **HOD**

P18PECM054	**GIS IN CONSTRUCTION ENGINEERING AND MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours– 45	3	0	0	3
	Prerequisite Course – Geographic and Information System				
	Course Coordinator Name & Department : Mr.K.Venkatraman, Civil Engineering				

COURSE OBJECTIVES: To introduce the elements of GIS as applied to construction management and achieve awareness on application techniques.

COURSE OUTCOMES (COs):		**Revised Bloom's Taxonomy**
CO1	Know the characteristics of map and map projections.	An
CO2	Understand the various types of data, data analysis methods and data quality requirements.	An & Ap
CO3	Know the concepts of raster and vector data structure and applications of DEM.	Ap
CO4	Know the Measurement, Buffering, Overlaying and Components of data quality.	An
CO5	Understand means of getting suitable data output and to use the data output for construction management using GIS tools.	E
CO6	Know the concepts of fields of application and natural resource management	Ap & 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	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
2	CO1	2			1		2		1
	CO2	2	1					1	
	CO3	2			1	1		1	3
	CO4	2			1	1	2		1
	CO5	2	3			2			
	CO6	2			1		1	2	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	**Professional Elective (PE)**	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
4	Approval	Meeting of Academic Council, May 2018				

UNIT I-INTRODUCTION TO GIS **9**

GIS - Definition - Components of GIS -Maps - Definition - Types of Maps - Characteristics of Maps - Map Projections -- Hardware, Software and Organizational Context - GIS software

UNIT II-TYPES OF DATA **9**

Data Types - Spatial and Non-Spatial - Spatial Data - Points, Lines and areas- Non-spatial data - Nominal, Ordinal, Interval and Ratio - Digitizer - Scanner - Editing and Cleaning - Geo reference data

UNIT III-DATA STRUCTURE **9**

Raster and Vector Data Structure - Raster data storage - Run length, Chain and Block Coding - Vector Data Storage - Topology - Topological Models - Arc Node Structure - Surface Data - DEM - Grid DEM and TIN structure- Applications of DEM

UNIT IV-DATA QUALITY **9**

Reclassification - Measurement - Buffering - Overlaying - SQL for Queries - Neighbourhood and zonal operations - Data Quality - Components of data quality - Sources of errors in GIS - Meta data

UNIT V-DIFFERENT TYPES OF OUTPUT **9**

Output - Maps, Graphs, Charts, Plots , Reports - Printers - Plotters - Fields of application - Natural Resource Management, construction management-Parcel based, AM/FM applications examples - Case study

REFERENCES

1. Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1998
2. Robert Laurini and Derek Thompson, Fundamentals of Spatial Information Systems, Academic Press, 1996
3. Anji Reddy, Remote Sensing and Geographical Information Systems , BS Publications 2001
4. Srinivas M.G. (Edited by), Remote Sensing Applications, Narosa Publishing House, 2001
5. Rhind, D., Understanding of GIS, The ARC / INFO Method, ESRI Press. 1990
6. https://www.slideshare.net/KushPatel115/application-of-gis-in-construction-management
7. https://www.hindawi.com/journals/ace/2017/1048540/
8. https://iarjset.com/upload/2015/june-15/IARJSET%2029.pdf
9. https://www.esri.com/library/brochures/pdfs/gis-sols-for-civil-engineering.pdf
10. https://nptel.ac.in/courses/105/102/105102015/

Course Coordinator **HOD**

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM

M.TECH – INFORMATION TECHNOLOGY
FULL TIME
I – IV SEMESTERS

I-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCMA106	PC	Mathematical Foundations of Information Science	3	0	0	3
P18PCIT101	PC	Data Structures and Algorithms	3	0	0	3
	PE	Program Elective-I	3	0	0	3
	PE	Program Elective-II	3	0	0	3
P18PRIT103	PR	Research Methodology and Intellectual Property Rights(IPR)	2	0	0	2
	AC	Audit Course	2	0	0	0
PRACTICAL						
P18PEIT1L1	PC	Program Elective Lab-I	0	0	4	2
P18PEIT1L2	PC	Program Elective Lab-II	0	0	4	2

Total Credits : 18

II-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCIT201	PC	Mobile Computing	3	0	0	3
P18PCIT202	PC	Big Data Analytics	3	0	0	3
	PE	Program Elective-III	3	0	0	3
	PE	Program Elective-IV	3	0	0	3
	AC	Audit Course	2	0	0	0
PRACTICAL						
P18PEIT2L1	PC	Program Elective Lab-III	0	0	4	2
P18PEIT2L2	PC	Program Elective Lab-IV	0	0	4	2
P18PRIT2P1	PR	Mini Project	0	0	12	2

Total Credits: 18

III – SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject Name**	**L**	**T**	**P**	**C**
	PEC	Program Elective-V	3	0	0	3
	OE	Open Elective	3	0	0	3
PROJECT						
P18PRIT3P1	PR	Project Phase-I	0	0	20	10

Total Credits : 16

IV SEMESTER						
PROJECT						
P18PRIT4P1	PR	Project Phase-II	0	0	32	16

Total Credits : 16

Total Credits : 68

LIST OF ELECTIVES

PROGRAM ELECTIVES - I

Sub. Code	Subject	CONTACT PERIODS	L	T	P	C
P18PEIT011	Internet Of Thing	3	3	0	0	3
P18PEIT012	Artificial Intelligence	3	3	0	0	3
P18PEIT013	Cloud Computing and Virtualization	3	3	0	0	3

PROGRAM ELECTIVES - II

Sub. Code	Subject	CONTACT PERIODS	L	T	P	C
P18PEIT021	Wireless Networks	3	3	0	0	3
P18PEIT022	Machine Learning	3	3	0	0	3
P18PEIT023	Internet and Web Technology	3	3	0	0	3

PROGRAM ELECTIVES - III

Sub. Code	Subject	CONTACT PERIODS	L	T	P	C
P18PEIT031	Data Warehousing and Data Mining	3	3	0	0	3
P18PEIT032	Cryptography and Network Security	3	3	0	0	3
P18PEIT033	Fuzzy Logic And Its Application	3	3	0	0	3

PROGRAM ELECTIVES - IV

Sub. Code	Subject	CONTACT PERIODS	L	T	P	C
P18PEIT041	Human Computer Interaction	3	3	0	0	3
P18PEIT042	High Speed Networks	3	3	0	0	3
P18PEIT043	Computational Intelligence	3	3	0	0	3

PROGRAM ELECTIVES - V

Sub. Code	Subject	CONTACT PERIODS	L	T	P	C
P18PEIT051	Natural Language Processing	3	3	0	0	3
P18PEIT052	Knowledge Engineering And Expert System	3	3	0	0	3
P18PEIT053	Internet & Web Security Protocols	3	3	0	0	3

OPEN ELECTIVES

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18OEBA001	Business Analytics	3	3	0	0	3
P18OEMA002	Operations Research	3	3	0	0	3
P18OEME003	Industrial Safety	3	3	0	0	3
P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
P18OEME005	Composite Materials	3	3	0	0	3
P18OEEE005	Waste to Energy	3	3	0	0	3

AUDIT COURSES I & II

SL. NO.	CODE NO.	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM

M.TECH – INFORMATION TECHNOLOGY
PART TIME
I – VI SEMESTERS

I-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCMA106	PC	Mathematical Foundations of Information Science	3	0	0	3
P18PCIT101	PC	Data Structures and Algorithms	3	0	0	3
P18PRIT103	PR	Research Methodology and Intellectual Property Rights(IPR)	2	0	0	2
PRACTICAL						
P18PEIT1L1	PC	Program Elective Lab-I	0	0	4	2

Total Credits :10

II-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCIT201	PC	Mobile Computing	3	0	0	3
P18PCIT202	PC	Big Data Analytics	3	0	0	3
PRACTICAL						
P18PEIT2L1	PC	Program Elective Lab-III	0	0	4	2
P18PRIT2P1	PR	Mini Project	0	0	12	2

Total Credits :10

III-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
	PE	Program Elective-I	3	0	0	3
	PE	Program Elective-II	3	0	0	3
	AC	Audit Course-I	2	0	0	0
PRACTICAL						
P18PEIT1L4	PE	Elective Lab -II	0	0	4	2

Total Credits :08

IV-SEMESTER
THEORY

Sub. Code	Category	Subject	L	T	P	C
	PE	Program Elective-III	3	0	0	3
	PE	Program Elective-IV	3	0	0	3
	AC	Audit Course-II	2	0	0	0
PRACTICAL						
P18PEIT2L4	PC	Program Elective Lab-IV	0	0	4	2

Total Credits :08

V – SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject Name**	**L**	**T**	**P**	**C**
	PE	Program Elective-V	3	0	0	3
	OE	Open Elective	3	0	0	3
PROJECT						
P18PRIT3P1	PR	Project Phase-I	0	0	20	10

Total Credits : 16

VI SEMESTER						
PROJECT						
P18PRIT4P1	PR	Project Phase-II	0	0	32	16

Total Credits : 16

TOTAL CREDITS FOR THE PROGRAM: 68

CURRICULUM AND SYLLABUS (R2018)
CHOICE BASED CREDIT SYSTEM

M.TECH – COMPUTER SCIENCE AND ENGINEERING
(FULL TIME)
I – IV SEMESTERS

I-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCMA106	PC	Mathematical Foundation of Computer Science	3	0	0	3
P18PCCS101	PC	Advanced Data Structures and Algorithms	3	0	0	3
	PE	Program Elective-I	3	0	0	3
	PE	Program Elective-II	3	0	0	3
P18PRCS103	PR	Research Methodology & IPR	2	0	0	2
	AC	Audit Course	2	0	0	0
PRACTICAL						
P18PCCS1L1	PC	Advanced Data Structures & Algorithm Lab	0	0	4	2
P18PECS1L2	PC	Elective Lab	0	0	4	2

Total Credits :18

II-SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject**	**L**	**T**	**P**	**C**
P18PCCS201	PC	Cloud Computing	3	0	0	3
P18PCCS202	PC	Soft Computing	3	0	0	3
	PE	Program Elective-III	3	0	0	3
	PE	Program Elective-IV	3	0	0	3
	AC	Audit Course	2	0	0	0
PRACTICAL						
P18PCCS2L3	PC	Soft Computing Lab	0	0	4	2
P18PECS2L4	PC	Elective Lab	0	0	4	2
P18PRCS2P1	PR	Mini Project with Seminar	0	0	12	2

Total Credits :18

III – SEMESTER						
THEORY						
Sub. Code	**Category**	**Subject Name**	**L**	**T**	**P**	**C**
P18PECSXXX	PE	Program Elective-V	3	0	0	3
P18PECSXXX	OE	Open Elective	3	0	0	3
PROJECT						
P18PRCS3P2	PR	Project Phase-I	0	0	20	10

Total Credits : 16

IV -SEMESTER						
PROJECT						
P18PRCS4P3	PR	Project Phase-II	0	0	32	16

Total Credits : 16

TOTAL CREDITS FOR THE PROGRAM :68

PROGRAM ELECTIVE - I

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18PECS011	Machine Learning	3	3	0	0	3
P18PECS012	Wireless Sensor Networks	3	3	0	0	3
P18PECS013	Introduction to Intelligent Systems	3	3	0	0	3

PROGRAM ELECTIVE - II

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18PECS021	Data Science	3	3	0	0	3
P18PECS022	Distributed Systems	3	3	0	0	3
P18PECS023	Advanced Wireless and Mobile Networks	3				

PROGRAM ELECTIVE - III

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18PECS031	Data Preparation and Analysis	3	3	0	0	3
P18PECS032	Secure Software Design & Enterprise Computing	3	3	0	0	3
P18PECS033	Computer Vision	3				

PROGRAM ELECTIVE - IV

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18PECS041	Human and Computer Interaction	3	3	0	0	3
P18PECS042	GPU Computing	3	3	0	0	3
P18PECS043	Digital Forensics	3				

PROGRAM ELECTIVE - V

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18PECS051	Mobile Communication	3	3	0	0	3
P18PECS052	Compiler for HPC	3	3	0	0	3
P18PECS053	Optimization Techniques	3	3	0	0	3

OPEN ELECTIVE-I

Sub. Code	Subject Name	CONTACT PERIODS	L	T	P	C
P18OECS001	Business Analytics	3	3	0	0	3
P18OEMA002	Operations Research	3	3	0	0	3
P18OEME003	Industrial Safety	3	3	0	0	3
P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
P18OEME005	Composite Materials	3	3	0	0	3
P18OEEE005	Waste to Energy	3	3	0	0	3

AUDIT COURSES I & II

SL. NO.	CODE NO.	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

P18PCMA106	MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Discrete Mathematics				
	Course Designed by : Dept. of Mathematics				

OBJECTIVES

- To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Softwareengineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To developthe understanding ofthe mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

COURSE OUTCOMES (COs)

CO1	To understand the basic notions of discrete and continuous probability.
CO2	Explain the basics of Sampling and Statistical models.
CO3	Understand concept about Graph Theory.
CO4	Explain basics about Datamining, Computer Architecture and Software Engineering.
CO5	Explain Understand about various recent trends in Computer Science like bio informatics, Soft Computing and Computer Vision.

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			M	M	M		M		M
	CO2	H	M	M							M	
	CO3	H	H		M				M			M
	CO4	H	H			M	M	M		M	M	M
	CO5	H	M									H
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCMA106 Mathematical Foundation of Computer Science	H	M	-	-	M	M	-	-	H	-	M

UNIT 1 INTRODUCTION 9

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

UNIT 2 SAMPLING 9

Random samples, sampling distributions of estimators, Methods of Moments andMaximum Likelihood,Statistical inference, Introduction to multivariate statistical models: regression andclassification problems, principal components analysis, The problem of overfitting model assessment.

UNIT 3 GRAPH THEORY 9

Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits andeuler cycles.Permutations and Combinations with and without repetition.Specialized techniques to solve combinatorial enumeration problems.

UNIT 4 COMPUTER SCIENCE AND ENGINEERING APPLICATIONS 9

Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributedsystems, Bioinformatics, Machine learning.

UNIT 5 RECENT TRENDS 9

Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bio informatics, soft computing, and computer vision.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. John Vince, Foundation Mathematics for Computer Science, Springer.

2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications.Wiley.

REFERENCES:

1. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.

2. Alan Tucker, Applied Combinatorics, Wiley

3.https://web.stanford.edu/class/cs103/notes/Mathematical%20Foundations%20of%20Computing.pdf

P18PCCS101	**ADVANCED DATA STRUCTURES AND ALGORITHMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: UG level course in Data Structures				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness

COURSE OUTCOMES (COs)	
CO1	Understand the implementation of symbol table using hashing techniques..
CO2	Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
CO3	Develop algorithms for text processing applications.
CO4	Identify suitable data structures and develop algorithms for computational geometry problems.
CO5	Understand about Linear Programming Concepts

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	M		H	H	H			M		M	M
	CO2		M				M					
	CO3				H	M		M	M	M		M
	CO4	M	H	M	H				M			
	CO5	M		H	M	M	M	H		M	M	M
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS101 Advanced Data Structures and Algorithms	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 DICTIONARIES 9

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT 2 SKIP LISTS AND TREES 9

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

UNIT 3 TEXT PROCESSING 9

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT4 SORTING 9

Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT 5 LINEAR PROGRAMMING 9

Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Ellis Horowitz, SartajSahni,Dinesh Mehta, “Fundamentals of Data Structures in C++”Galgotia book source, 2009.
2. Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest, “Introduction to Algorithms”, MIT press and McGraw Hill, 2001.
3. The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

REFERENCES:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

3. https://www.udemy.com/introduction-to-data-structures/

4."Algorithm Design" by Kleinberg and Tardos.

P18PRCS103	**RESEARCH METHODOLOGY & IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Professional Courses				
	Course Designed by :Department of Management Studies				

OBJECTIVES

To know the various types of Formulation of Research Task,modeling and simulation, analysis of reports and report writing.

COURSE OUTCOMES (COs)	
CO1	Understand research problem formulation.
CO2	Analyze research related information
CO3	Follow research ethics
CO4	Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

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	M		H	M	M		H	H		H
	CO2	M			M			M	M			M
	CO3		M	M		M	M				M	
	CO4	M			M					M		M

	CO5	M	M		M		M	M	M			
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS103 Research Methodology & IPR	H	M	-	H	M	H	M	H	H	-	M

UNIT 1: INTRODUCTION 9

Meaning of research problem, Sources of research problem, Criteria Characteristics ofa good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis,interpretation, Necessary instrumentations

UNIT 2: ANALYSIS 9

Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT 3: TECHNICAL WRITING 9

Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT 4: INTRODUCTION 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process ofPatenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT.

UNIT 5: PATENT RIGHTS

9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patentinformation and databases.Geographical Indications.Administration of Patent System.New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992.

REFERENCES:

1. Niebel , "Product Design", McGraw Hill, 1974.
2. Asimov , "Introduction to Design", Prentice Hall, 1962.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

P18PCCS1L1	**ADVANCED DATA STRUCTURE AND ALGORITHM LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Data structure & Algorithm				
	Lab Manual Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To learn to implement iterative and recursive algorithms.
- To learn to design and implement algorithms using hill climbing and dynamic programming techniques.
- To learn to implement shared and concurrent objects.
- To learn to implement concurrent data structures.

COURSE OUTCOMES (COs)

CO1	Design and apply iterative and recursive algorithms.
CO2	Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.
CO3	Design and implement optimization algorithms for specific applications.
CO4	Design and implement randomized algorithms.
CO5	Design appropriate shared objects and concurrent objects for applications.

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	M		H	H	H			M		M	M
	CO2		M				M					
	CO3				H	M		M	M	M		M
	CO4	M	H	M	H				M			
	CO5	M		H	M	M	M	H		M	M	M
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS1L1 Advanced Data Structures and Algorithms Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS:

1. Implementation of graph search algorithms.
2. Implementation and application of network flow and linear programming problems.
3. Implementation of algorithms using the hill climbing and dynamic programming design techniques.
4. Implementation of recursive backtracking algorithms.
5. Implementation of randomized algorithms.
6. Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks.
7. Developing applications involving concurrency.

TOTAL NO.OF PERIODS: 30

P18PCCS201	**CLOUD COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Distributed Computing, Grid Computing				
	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.

COURSE OUTCOMES (COs)	
CO1	Understand the fundamental principles of distributed computing.
CO2	Understand how the distributed computing environments known as Grids can be built from lower level services.
CO3	Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
CO4	Analyze the performance of Cloud Computing.
CO5	Understand the concept of Cloud Security.

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	M		H	H	H			M		M	M
	CO2		M				M					
	CO3				H	M		M	M	M		M
	CO4	M	H	M	H				M			
	CO5	M		H	M	M	M	H		M	M	M
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS201 Cloud Computing	M	H	M	H	M	-	-	-	H	M	M

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

P18PCCS202	SOFT COMPUTING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Artificial Intelligence, Machine Learning				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide student an hand-on experience on MATLAB to implement various strategies

COURSE OUTCOMES (COs)

CO1	Identify and describe soft computing techniques and their roles in building intelligent machines.
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
CO3	Apply genetic algorithms to combinatorial optimization problems.
CO4	Evaluate and compare solutions by various soft computing approaches for a given problem.
CO5	Learn Arrays and array operations, Functions and Files, neural network.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS202 Soft Computing	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 UNDERSTANDING ABOUT SOFT COMPUTING 9

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

UNIT 2 FUZZY LOGIC **9**

Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT 3 NEURAL NETWORKS **9**

Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

UNIT4 GENETIC ALGORITHMS **9**

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

UNIT 5 MATLAB/PYTHON LIB **9**

Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic , Recent Trends' in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.

REFERENCES:

1. MATLAB Toolkit Manual
2. **http://users.du.se/~jwe/fuzzy/NFL/F9.PDF**

P18PCCS2L3	SOFT COMPUTING LAB	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic knowledge of mathematics				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions i strengthen the dialogue between the statistics and soft computing research communities in orde cross-pollinate both fields and generate mutual improvement activities. Soft Computing i consortia of methodologies which collectively provide a body of concepts and techniques designing intelligent systems.

COURSE OUTCOMES (COs)

CO1	Identify and describe soft computing techniques and their roles in building intelligent machines.
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
CO3	Apply genetic algorithms to combinatorial optimization problems.
CO4	Evaluate and compare solutions by various soft computing approaches for a given problem.
CO5	Learn Arrays and array operations, Functions and Files, neural network.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Professional Course (PC)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PCCS2L3 Soft Computing Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS:

1. Write a Program For Implementing Linear Saturating Function.
2. Study and Analysis Of Art Model.
3. Write a Program For Error Back Propagation Algorithm (Ebpa) Learning.
4. Study and Analysis Of CPN
5. Study and Analysis Of Genetic Algorithm Life Cycle.
6. Study and Analysis Of Fuzzy Vs Crisp Logic.
7. Write a Program of Perceptron Training Algorithm.
8. Write a Program To Implement Hebb's Rule
9. Write a Program To Implement Of Delta Rule
10. Write a Program For Back Propagation Algorithm
11. Write a Program To Implement Logic Gates.

P18PRCS4P3	Project Phase-II	L	T	P	C
	Total Contact Hours –32 hours per week	0	0	32	16
	Prerequisite –UG Level Project Work				
	Course Designed by – Dept. of Computer Science &Engineering.				

OBJECTIVES

- Learn to work as a member of a project team.
- Understand project management tasks.
- Develop a hardware / software solution for a real-time, industry relevant problem.

COURSE OUTCOMES (COs)	
CO1	Apply knowledge of basic science and engineering to Computer Science &Engineering problems
CO2	Implement the simple applications and verify using modern simulation tools.
CO3	Identify, formulate, and model engineering equipment
CO4	Recognize the real world applications and to solve with core engineering knowledge.
CO5	Analyze and work on multidisciplinary tasks, Choose latest tools, Software and Equipment to solve real world problems.

PROGRAM ELECTIVE - I

P18PECS011	MACHINE LEARNING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Data ware housing and Datamining				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies

COURSE OUTCOMES (COs)	
CO1	Extract features that can be used for a particular machine learning approach in various IOT applications.
CO2	To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
CO3	To mathematically analyse various machine learning approaches and paradigms.
CO4	Understand how to apply a variety of learning algorithms to data.
CO5	Understand how to perform evaluation of learning algorithms and model selection.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS011 Machine Learning	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 SUPERVISED LEARNING 9

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Nave Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

UNIT 2 UNSUPERVISED LEARNING 9

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

UNIT 3 EVALATION 9

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

UNIT 4 SPARSE MODELING 9

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

UNIT 5 SCALABLE MACHINE LEARNING 9

Scalable Machine Learning (Online and Distributed Learning), A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

TOTAL NO OF PERIODS : 45

TEXT BOOKS:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009.

REFERENCES:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
2. https://www.coursera.org/learn/machine-learning

P18PECS012	WIRELESS SENSOR NETWORKS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks				
	Course Designed by : Department of Computer Science and Engineering				

OBJECTIVES

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

COURSE OUTCOMES (COs)

CO1	Describe and explain radio standards and communication protocols for wireless sensor networks
CO2	Explain the function of the node architecture and use of sensors for various applications.
CO3	Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.
CO4	Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.
CO5	Describe and analyse various routing protocols and WSN standards.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS012 Wireless Sensor Networks	M	H	M	H	M	M	-	-	H	M	M

UNIT 1 INTRODUCTION 9

Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture Hardware Platforms: Motes, Hardware parameters

UNIT 2 INTRODUCTION TO NS-3 9

Introduction to Network Simulator 3 (ns-3), Description of the NS-3 core module and simulation example.

UNIT 3 MEDIUM ACCESS CONTROL PROTOCOL DESIGN 9

Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

UNIT 4 SECURITY 9

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

UNIT 5 ROUTING PROTOCOLS 9

Routing protocols: Introduction, MANET protocols Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks. Advanced topics - Recent development in WSN standards, software applications.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. W. Dargie and C. Poellabauer, “Fundamentals of Wireless Sensor Networks –Theory and Practice”, Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, “wireless sensor networks -Technology, Protocols, and Applications”, Wiley Interscience 2007

REFERENCES:

1. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010
2. www.tfb.edu.mk/amarkoski/WSN/Kniga-w02.

P18PECS013	INTRODUCTION TO INTELLIGENT SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Artificial Intelligence and Expert Systems				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
- It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature

COURSE OUTCOMES (COs)

CO1	Able to Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyse and compare the relative merits of a variety of AI problem solving techniques.
CO2	Explain about Knowledge representation, Fuzzy logic and Neural networks.
CO3	Develop knowledge of decision making and learning Methods.
CO4	Describe the use of AI to solve English Communication problems.
CO5	Explain the concept Knowledge Representation.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K

	P18PECS013 Introduction to Intelligent Systems	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 ARTIFICIAL NEURAL NETWORKS 9

Biological foundations to intelligent systems I: Artificial neural networks, Back propagation networks, Radial basis function networks, and recurrent networks.

UNIT 2 FUZZY LOGIC 9

Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

UNIT 3 SEARCH METHODS 9

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

UNIT 4 KNOWLEDGE REPRESENTATION 9

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

UNIT 5 REASONING 9

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning, Recent trends in Fuzzy logic, Knowledge Representation.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.

2.CrinaGrosan and Ajith Abraham(2011) Intelligent Systems: A Modern Approach , Springer

REFERENCES:

1. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.
2. https://www.datasociety.net/pubs/fow/IntelligentSystems.pdf

PROGRAM ELECTIVE I - LAB

P18PECS011L1	MACHINE LEARNING LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Data ware housing and Datamining				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies

COURSE OUTCOMES (COs)

CO1	Extract features that can be used for a particular machine learning approach in various IOT applications.
CO2	To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
CO3	To mathematically analyze various machine learning approaches and paradigms.
CO4	Understand how to apply a variety of learning algorithms to data.
CO5	Understand how to perform evaluation of learning algorithms and model selection.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS011L1 Machine Learning Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.

2. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

4. Write a program to implement the naïve Bayesian classifier for a sample training data set.

5. Write a program to implement k-Nearest Neighbour algorithm.

6.Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

7. Using Train Test to Prevent Over fitting a Polynomial Regression Bayesian Methods Concepts.

8. Using Sample Dataset implement Mean / Median /Mode Variation of Standard Deviation.

9. Using Train Test to find Covariance and Correlation for given dataset.

P18PECS012L1	WIRELESS SENSOR NETWORKS LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Computer Networks				
	Course Designed by : Department of Computer Science and Engineering				

OBJECTIVES

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

COURSE OUTCOMES (COs)

CO1	Describe and explain radio standards and communication protocols for wireless sensor networks
CO2	Explain the function of the node architecture and use of sensors for various applications.
CO3	Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.
CO4	Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.
CO5	Describe and analyse various routing protocols and WSN standards.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS012L1 Wireless Sensor Networks Lab	M	H	M	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1. Implement IP forwarding within a LAN and across a router.

2. Study the working of spanning tree algorithm by varying the priority among the switches.

3. Understand the working of "Connection Establishment" in TCP using any Network Simulator.

4. Implement how the Data Rate of a Wireless LAN network varies as the distance between the Access Point and the wireless nodes is varied.

5. Study the working and routing table formation of Interior routing protocols.

6. Study the characteristic curve throughput versus offered traffic for a Slotted ALOHA system.

7. Understand the impact of bit error rate on packet error and investigate the impact of error in hub based CSMA / CD network.

8. Analyze the performance of a MANET with increasing node density.

9. Analyze the performance of a MANET with increasing node mobility.

10. Study the working of EIGRP and formation of EIGRP Routing table.

P18PECS013L1	INTRODUCTION TO INTELLIGENT SYSTEMS LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Artificial Intelligence and Expert Systems				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
- It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature

COURSE OUTCOMES (COs)

CO1	Able to Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyse and compare the relative merits of a variety of AI problem solving techniques.
CO2	Explain about Knowledge representation, Fuzzy logic and Neural networks.
CO3	Develop knowledge of decision making and learning Methods.
CO4	Describe the use of AI to solve English Communication problems.
CO5	Explain the concept Knowledge Representation.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS013L1 Introduction to Intelligent Systems Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Write a program to Solve 8 Queens Problem.

2. Write a program for implement Depth First Search.

3. Write a program for implement Breadth First Search.

4. Solve Travelling Salesman Problem.

5. Solve 8 puzzle problem using best first search.

6. Developing an Artificial Neural Network.

7. Using ANN for Problem Solving.

8. Working from the Command Line of Matlab to build fuzzy logic based application.

PROGRAM ELECTIVE - II

P18PECS021	**DATA SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Data ware housing and Data mining				
	Course Designed by : Department of Computer Science and Engineering				

OBJECTIVES

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Produce Python code to statistically analyse a dataset
- Critically evaluate data visualizations based on their design and use for communicating stories from data

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.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS021 Data Science	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 INTRODUCTION 9

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT 2 DATA COLLECTION AND MANAGEMENT 9

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.

UNIT 3 DATA ANALYSIS 9

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT 4 DATA VISUALIZATION 9

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT 5 APPLICATIONS 9

Applications of Data Science, Technologies for visualization, Bokeh (Python) Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman.Mining of Massive Datasets.v2.1, Cambridge University Press.

REFERENCES:

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. Wagner, S., Steinmetz, M., Bode, A., Müller, M.M. (Eds.),, High Performance Computing in Science and Engineering, Garching/Munich, Springer Verlog, 2010.
4. https://ischool.syr.edu/media/documents/2012/3/DataScienceBook1_1.pdf

P18PECS022	DISTRIBUTED SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Database Management Systems				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

COURSE OUTCOMES (COs)

CO1	Design trends in distributed systems.
CO2	Apply network virtualization.
CO3	Apply remote method invocation and objects.
CO4	Understand basic concepts of relational data model and entity-relationship model.
CO5	Outline relational database design, relational algebra and database language SQL.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS022 Distributed Systems	M	H	M	H	M	M	-	-	H	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

UNIT 1 INTRODUCTION 9

Introduction-Distributed data processing, What is a DDBS, Advantages and disadvantages of DDBS, Problem areas, Overview of database and computer network concepts, distributed database management system architecture- Transparencies in a distributed DBMS; Distributed DBMS architecture, Global directory issues.

UNIT 2 DISTRIBUTED DATABASE DESIGN 9

Alternative design strategies, Distributed design issues, Fragmentation, Data allocation Semantics data control - View management, Data security, Semantic Integrity Control, Query processing issues - Objectives of query processing; Characterization of query processors, Layers of query processing, Query decomposition, Localization of distributed data.

UNIT 3 DISTRIBUTED QUERY OPTIMIZATION 9

Distributed query optimization-Factors governing query optimization, Centralized query optimization, Ordering of fragment queries, Distributed query optimization algorithms, Transaction management - The transaction concept, Goals of transaction management, Characteristics of transactions, Taxonomy of transaction models, concurrency control-

Concurrency control in centralized database systems, Concurrency control in DDBSs, Distributed concurrency control algorithms, Deadlock management.

UNIT 4 RELIABILITY **9**

Reliability issues in DDBSs, Types of failures, Reliability techniques, Commit protocols, Recovery protocols.

UNIT 5 PARALLEL DATABASE SYSTEMS **9**

Parallel database systems - Parallel architectures; parallel query processing and optimization, load balancing, Advanced topics - Mobile Databases, Distributed Object Management, Multi-databases.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 2011.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley.

REFERENCES:

1. M. Tamer Ozsu and Patrick Valduriez, "Principles of Distributed Database Systems", Springer Science + Business Media , 3rd Edition, 2011.
2. Sandro Fiore, Giovanni Aloisio ,"Grid and Cloud Database management",ACM,2011.
3. David Taniar, Clement H.C.Leung, WennyRahayu, SushantGoel , "High performance parallel Database processing and Grid databases" , John Wiley & Sons, 2008.
4. http://barbie.uta.edu/~jli/Resources/MapReduce&Hadoop/Distributed%20Systems%20Principles%20and%20Paradigms.pdf.

P18PECS023	**ADVANCED WIRELESS AND MOBILE NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Computer Networks				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- The students should get familiar with the wireless/mobile market and the future needs and challenges
- To get familiar with key concepts of wireless networks, standards, technologies and

their basic operations • To learn how to design and analyse various medium access • To learn how to evaluate MAC and network protocols using network simulation software tools. • The students should get familiar with the wireless/mobile market and the future needs and challenges.

COURSE OUTCOMES (COs)	
CO1	Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases
CO2	Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
CO3	Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks
CO4	Design wireless networks exploring trade-offs between wire line and wireless links.
CO5	Develop mobile applications to solve some of the real world problems.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS023 Advanced Wireless and Mobile Networks	M	H	M	H	M	M	-	-	H	M	M

UNIT 1 INTRODUCTION 9

Introduction- Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc. Wireless Local Area Networks- IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards,

Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

UNIT 2 WIRELESS CELLULAR NETWORKS 9

Wireless Cellular Networks-1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

UNIT 3 WIRELESS SENSOR NETWORKS 9

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview Wireless Sensor Networks - Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

UNIT 4 WIRELESS PANS 9

WIRELESS PANs - Bluetooth AND Zigbee, Introduction to Wireless Sensors.

UNIT 5 SECURITY 9

Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication. Advanced topics - IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200

REFERENCES:

1. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
2. Yi Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
3. http://pws.npru.ac.th/sartthong/data/files/Wireless%20Networks%20%2book.pdf

PROGRAM ELECTIVE II- LAB

P18PECS021L1	DATA SCIENCE LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Data ware housing and Data mining				
	Course Designed by : Department of Computer Science and Engineering				

OBJECTIVES

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyse a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

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.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS021L1 Data Science Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Install, configure and run Hadoop and HDFS.
2. Implement word count / frequency programs using MapReduce.
3. Implement an MR program that processes a weather dataset R.
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 / R.

P18PECS022L1	**DISTRIBUTED SYSTEMS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**4**	**2**
	Prerequisite: Database Management Systems				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

COURSE OUTCOMES (COs)	
CO1	Design trends in distributed systems.
CO2	Apply network virtualization.
CO3	Apply remote method invocation and objects.
CO4	Understand basic concepts of relational data model and entity-relationship model.
CO5	Outline relational database design, relational algebra and database language SQL.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS022L1 Distributed Systems Lab	H	M	-	-	M	-	M	-	H	-	L

LIST OF EXPERIMENTS

1. Implement concurrent echo client-server application.
2. Implement concurrent day-time client-server application.
3. Incrementing a counter in shared memory.
4. Create CORBA based server-client application.
5. Design XML Schema and XML instance document .
6. Configuring reliability and security options .
7. Monitor SOAP request and response packets. Analyze parts of it and compare them with the operations (java functions) headers.
8. Implementing Publish/Subscribe Paradigm using Web Services, ESB and JMS.
9. Implementing Stateful grid services using Globus WS-Core-4.0.3.

P18PECS023L1	**ADVANCED WIRELESS AND MOBILE NETWORKS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	**0**	**0**	**4**	**2**
	Prerequisite: Computer Networks				
	Course Designed by :Department of Computer Science and Engineering				

OBJECTIVES

- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
- To learn how to design and analyze various medium access.
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.

COURSE OUTCOMES (COs)

CO1	Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases
CO2	Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
CO3	Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks
CO4	Design wireless networks exploring trade-offs between wire line and wireless links.
CO5	Develop mobile applications to solve some of the real world problems.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS023L1 Advanced Wireless and Mobile Networks Lab	M	H	M	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1. To implement Code Division Multiple Access (CDMA).
2. To study various classes (such as Text Box, Choice Group , Drop Down) menus etc. and their implementation in J2ME.
3. To design a simple WML page using various WML tags.
4. To implement mobile network using NS2.
5. Study of Propagation Path Loss Models: Indoor & Outdoor.
6. To implement Baseband Communication.
7. Code Division Multiple Access - Multipath.
8. Set up and configuration of access point.

PROGRAM ELECTIVE - III

P18PECS031	DATA PREPARATION AND ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Data mining				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To prepare the data for analysis and develop meaningful Data Visualizations.

COURSE OUTCOMES (COs)

CO1	Able to extract the data for performing the Analysis.
CO2	Demonstrate use of Database for extracting and Cleaning data.
CO3	Explain methods of data analysis in a company, define business situations in which data processing methods are applicable, and define scope of use of different types of data base management systems.
CO4	Explain visualizations and Time series
CO5	Learn Traditional structure learning techniques.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS031 Data Preparation and Analysis	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 DATA GATHERING AND PREPARATION 9

Data formats, parsing and transformation, Scalability and real-time issues-Data extraction.

UNIT 2 DATA CLEANING **9**

Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation-Data cleaning.

UNIT 3 EXPLORATORY ANALYSIS **9**

Descriptive and comparative statistics, Clustering and association, Hypothesis generation-basic concepts on probability, statistic, linear algebra, and calculus.

UNIT 4 VISUALIZATION **9**

Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity- Map-reduce for machine learning.

UNIT 5 GRAPH MINING **9**

Traditional structure learning techniques: constraint-based and score-based algorithms- L1-based structure learning algorithm- Graph analysis- Auto-regression, non-linear time-series analysis.

TOTAL NO OF PERIODS: 45

TEXT BOOK:

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn,J. Myatt

REFERENCE:

1. https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf .

P18PECS032	**SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Network Security				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To prepare the data for analysis and develop meaningful Data Visualizations.

COURSE OUTCOMES (COs)

CO1	To fix software flaws and bugs in various software.
CO2	To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
CO3	Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.

CO4	Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws
CO5	Understand SQL injection and SQL injection Attacks.

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	H	H				M			M
	CO2			M	M					L		
	CO3	H	M	H		M	M	H	M		M	
	CO4	M			M							
	CO5		H	H	M					M		L
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS032 Secure Software Design and Enterprise Computing	M	H	M	H	M	M	-	-	H	M	M

UNIT 1 SECURE SOFTWARE DESIGN 9

Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

UNIT 2 ENTERPRISE APPLICATION DEVELOPMENT 9

Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

UNIT 3 ENTERPRISE SYSTEMS ADMINISTRATION 9

Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

UNIT 4 TROUBLE SHOOTING 9

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

UNIT 5 EXCEPTION

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws. Case study of DNS server, DHCP configuration and SQL injection attack.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett

2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

REFERENCE:

1.https://pdfs.semanticscholar.org/presentation/ee34/ab60c7f71ee72ff67c2aa41c2ee1f4a5c.pdf.

P18PECS033	COMPUTER VISION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Image Processing.				
	Course Designed by : Dept. of Computer Science and Engineering				

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.
- Grasp the principles of state-of-the-art deep neural networks.

COURSE OUTCOMES (COs)

CO1	Developed the practical skills necessary to build computer vision applications.
CO2	To have gained exposure to object and 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	Implement motion related techniques.
CO5	Develop applications using computer vision techniques.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS033 Computer Vision	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 IMAGE ANALYSIS **9**

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

UNIT 2 EDGE DETECTION **9**

Edge detection, Edge detection performance, Hough transform, corner detection.

UNIT 3 SEGMENTATION **9**

Segmentation, Morphological filtering, Fourier transform.

UNIT 4 FEATURE EXTRACTION **9**

Feature Extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing.

UNIT 5 PATTERN ANALYSIS **9**

Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA,ICA, and Non-parametric methods. Recent trends in Activity Recognition, computational photography, Biometrics.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.

REFERENCES

1. Dictionary of Computer Vision and Image Processing, by Fisher et al.
2. **https://courses.cs.washington.edu/courses/cse455/09wi/Lects/lect1.pdf**

PROGRAM ELECTIVE III - LAB

P18PECS031L1	DATA PREPARATION AND ANALYSIS LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Data mining				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To prepare the data for analysis and develop meaningful Data Visualizations.

COURSE OUTCOMES (COs)

CO1	Able to extract the data for performing the Analysis.
CO2	Demonstrate use of Database for extracting and Cleaning data.
CO3	Explain methods of data analysis in a company, define business situations in which data processing methods are applicable, and define scope of use of different types of data base management systems.
CO4	Explain visualizations and Time series
CO5	Explain Graph mining and Various methods.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS031L1 Data Preparation and Analysis Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Demonstration of preprocessing on dataset geographical.arff

2. Demonstration of preprocessing on dataset weather.arff

3. Demonstration of Association rule process on dataset healthcare.arff using apriori algorithm

4. Demonstration of Association rule process on dataset sample.arff using apriori algorithm

5. Demonstration of classification rule process on dataset studentdata.arff using j48 algorithm

6. Demonstration of classification rule process on dataset employee.arff using j48 algorithm

7. Demonstration of classification rule process on dataset employee.arff using id3 algorithm

8. Demonstration of classification rule process on dataset employee.arff using naïve bayes algorithm.

9. Demonstration of clustering rule process on dataset webdata.arff using simple k-means.

10.Demonstration of clustering rule process on dataset studentdata.arff using simple kmeans.

P18PECS032L1	**SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Network Security				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To prepare the data for analysis and develop meaningful Data Visualizations.

COURSE OUTCOMES (COs)	
CO1	To fix software flaws and bugs in various software.
CO2	To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
CO3	Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
CO4	Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws
CO5	Understand SQL injection and SQL injection Attacks.

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	H	H				M			M
	CO2			M	M					L		
	CO3	H	M	H		M	M	H	M		M	
	CO4	M			M							
	CO5		H	H	M					M		L
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS032L1 Secure Software Design and Enterprise Computing Lab	M	H	M	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1.Cryptography- Secret-Key Encryption, Public-Key Encryption.

2. MAC(Message Authentication Code), Digital Signatures.

3. Diffie-Hellman Key Exchange.

4. Cross Site Scripting & Buffer Overflow Attack.

5. Code Injection Attacks: SQL Injection, PHP Injection.

6. DNS Spoofing, DNS Cache Poisoning, DNS Pharming, DNS Cache Analysis.

7.OS Finger printing, Banner Grabbing through telnet, Analysis of Hibernate and hosts file.

8. Email- E-mail Spoofing, E-mail Bombing, Header Analysis of E-mail Malware Analysis.

9. Malware Classification: Polymorphic and Metamorphic Malware, Virus, Rabbit, Trojans, Back Door, Spyware Understand the Tools and Techniques.

10. Web Application Vulnerabilities (DWAV), WebGoat, ProRat Trojan, Key Logger, Steganographer etc.

P18PECS033L1	COMPUTER VISION LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Image Processing.				
	Course Designed by : Dept. of Computer Science and Engineering				

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.
- Grasp the principles of state-of-the-art deep neural networks.

COURSE OUTCOMES (COs)

CO1	Developed the practical skills necessary to build computer vision applications.
CO2	To have gained exposure to object and 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	Implement motion related techniques.
CO5	Develop applications using computer vision techniques.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3				H	M		M	H	M		M
	CO4	M	H	M	H				M			
	CO5	M	M	H	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS033L1 Computer Vision Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Display of Gray scale Images.
2. Histogram Equalization.
3. Design of Non-linear Filtering.
4. Determination of Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain
7. Display of colour images
8. Conversion between colour spaces.
9. DWT of images.
10. Segmentation using watershed transform.

PROGRAM ELECTIVE - IV

P18PECS041	**HUMAN AND COMPUTER INTERACTION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Architecture				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Learn the foundations of Human Computer Interaction
- Be familiar with the design technologies for individuals and persons with disabilities
- Be aware of mobile Human Computer interaction.
- Learn the guidelines for user interface.

COURSE OUTCOMES (COs)

CO1	Understand fundamental design and evaluation methodologies of human computer interaction.
CO2	Design an interactive web interface on the basis of models studied
CO3	Understand the structure of cognitive models
CO4	Learn about Mobile Eco system design and tools.
CO5	Understand about Designing web interface and recent trends.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3			M	H	M		M	H	M		M
	CO4	M	H	H	H				M			
	CO5	M	M	M	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS041 Human and Computer Interaction	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 I/O CHANNELS & MEMORY 9

I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models– frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT 2 INTERACTIVE DESIGN BASICS 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 3 COGNITIVE MODELS 9

Cognitive models –Socio-Organizational issues and stake holder requirements–Communication and collaboration models-Hypertext, Multimedia and WWW**.**

UNIT 4 MOBILE ECOSYSTEM 9

Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT 5 DESIGNING WEB INTERFACES 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies. Recent Trends: Speech Recognition and Translation, Multimodal System.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

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)

3.Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O□Reilly, 2009.(UNIT-V)

REFERENCE:

1. **https://www.tutorialspoint.com/human_computer_interface/pdf_version.htmL**

P18PECS042	**GPU COMPUTING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Graphics				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To learn parallel programming with Graphics Processing Units (GPUs).

COURSE OUTCOMES (COs)	
CO1	Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs
CO2	Learn concepts memory hierarchy and performance evaluation.
CO3	Use OpenGL and CUDA to create real-time visualization coupled with simulations.
CO4	Understand GPU programs and synchronization.
CO5	Learn various case studies using Graphical Processing Computing.

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	H	H				M			L
	CO2			M	M					L		
	CO3	H	M			M	M	H	M		M	
	CO4	M			M							
	CO5		M	H		M		M		M		M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS042 GPU Computing	M	H	M	H	M	-	-	-	H	M	M

UNIT 1 INTRODUCTION **9**

History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA Open CL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps/ Wave fronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D/ 3D thread mapping, Device properties, Simple Programs.

UNIT 2 MEMORY **9**

Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories.

UNIT 3 SYNCHRONIZATION **9**

Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Work lists, Linked-lists. Synchronization across CPU and GPU **Functions**: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

UNIT 4 STREAMS **9**

Debugging GPU Programs. Profiling, Profile tools, Performance Aspects.

Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

UNIT 5 CASE STUDIES **9**

Image Processing, Graph algorithms, Simulations, Deep Learning Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu;Morgan Kaufman; 2010 (ISBN: 978-0123814722)

REFERENCES

1. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook;
2. Morgan Kaufman; 2012 (ISBN: 978-0124159334)
3. http://www.int.washington.edu/PROGRAMS/12-2c/week3/clark_01.pdf

P18PECS043	DIGITAL FORENSICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Cybercrime and Information Warfare, Computer Networks				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.

COURSE OUTCOMES (COs)

CO1	Understand relevant legislation and codes of ethics
CO2	Computer forensics and digital detective and various processes, policies and procedures
CO3	E-discovery, guidelines and standards, E-evidence, tools and environment.
CO4	Email and web forensics and network forensics
CO5	Learn about Mobile Forensics and various ACT.

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	H	H				M			M
	CO2			M	M					L		
	CO3	H	M			M	M	H	M		M	

	CO4	M			M							
	CO5		M	H		M			M	M		L
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS043 Digital Forensics	M	H	M	H	M	M	-	-	H	M	M

UNIT 1 DIGITAL FORENSICS SCIENCE 9

Forensics science, computer forensics, and digital forensics. **Computer Crime:** Criminalistics as it relates to the investigative process, analysis of cyber-Criminalistics area, holistic approach to cyber-forensics.

UNIT 2 CYBER CRIME SCENE ANALYSIS 9

Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT 3 EVIDENCE MANAGEMENT & PRESENTATION 9

Create and manage shared folders using operating system, importance of the forensic indset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT 4 COMPUTER FORENSICS 9

Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, **Network Forensics:** open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT 5 MOBILE FORENSICS **9**

mobile forensics techniques, mobile forensics tools. **Legal Aspects of Digital Forensics:** IT Act 2000, amendment of IT Act 2008.Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

TOTAL NO OF PERIODS: 45

TEXT BOOK:

1. John Sammons, The Basics of Digital Forensics, Elsevier.

REFERENCES:

1. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

2.https://www.researchgate.net/publication/228864187_An_Introduction_to_Digital_Forensics

.

PROGRAM ELECTIVE IV - LAB

P18PECS041L1	**HUMAN AND COMPUTER INTERACTION LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Computer Architecture				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Learn the foundations of Human Computer Interaction
- Be familiar with the design technologies for individuals and persons with disabilities
- Be aware of mobile Human Computer interaction.
- Learn the guidelines for user interface.

COURSE OUTCOMES (COs)	
CO1	Understand fundamental design and evaluation methodologies of human computer interaction.
CO2	Design an interactive web interface on the basis of models studied
CO3	Understand the structure of cognitive models
CO4	Learn about Mobile Eco system design and tools.
CO5	Understand about Designing web interface and recent trends.

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	M		H	H	H			M	H	M	H
	CO2		H				M					
	CO3			M	H	M		M	H	M		M
	CO4	M	H	H	H				M			
	CO5	M	M	M	M	M	M	H		M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS041L1 Human and Computer Interaction Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Interface for online shopping website.
2. e learning web site
3. Tele-shopping
4. Online banking
5. ATM interface
6. Travel reservation system
7. Booking of movie tickets
8. Railway enquiry
9. Online buying of books.
10. Online trading on Stock market
11. Hospital Management
12. Patients information storage
13. Placement agency
14. Event management

P18PECS042L1	GPU COMPUTING LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Computer Graphics				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To learn parallel programming with Graphics Processing Units (GPUs).

COURSE OUTCOMES (COs)

CO1	Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs
CO2	Learn concepts memory hierarchy and performance evaluation.
CO3	Use OpenGL and CUDA to create real-time visualization coupled with simulations.
CO4	Understand GPU programs and synchronization.
CO5	Learn various case studies using Graphical Processing Computing.

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	H	H				M			L
	CO2			M	M					L		
	CO3	H	M			M	M	H	M		M	
	CO4	M			M							
	CO5		M	H		M		M		M		M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS042L1 GPU Computing Lab	M	H	M	H	M	-	-	-	H	M	M

LIST OF EXPERIMENTS

1. Write a program for OpenGL and GLSL
2. Write a program to implement 3D graphics, lighting and textures.
3. Write a program to implement Raytracing.
4. Write a program to implement Bresenham's Line Drawing algorithm.
5. Write a program to implement Cohen Sutherland Clipping algorithm.
6. Write a program to perform various transformation of Line, Square and Rectangle.
7. Write a program to implement JPEG Compression scheme for still images.
8. Write a program to implement text compression algorithm.
9. Write a program to implement Bresenham's Circle Drawing algorithm.
10. Write a program to draw an ellipse using Bresenham's algorithm.

P18PECS043L1	DIGITAL FORENSICS LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Cybercrime and Information Warfare, Computer Networks				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of Steganography and mobile device forensics.

COURSE OUTCOMES (COs)

CO1	Understand relevant legislation and codes of ethics
CO2	Computer forensics and digital detective and various processes, policies and procedures
CO3	E-discovery, guidelines and standards, E-evidence, tools and environment.
CO4	Email and web forensics and network forensics
CO5	Learn about Mobile Forensics and various ACT.

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	H	H				M			M
	CO2			M	M					L		
	CO3	H	M			M	M	H	M		M	
	CO4	M			M							
	CO5		M	H		M			M	M		L
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS043L1 Digital Forensics Lab	M	H	M	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1. Database Vulnerabilities: Excessive Privileges Attack, Privilege Abuse, Unauthorized Privilege.
2. Blind SQL, Weak Authentication, Exposure of Data Backup Evidence Handling.
3. Registry, Slack Space, windows log file Analyzing Data from Networked Systems.
4. Log Files: Access Log, Security Log, Firewall Log, Server log.
5.E-mail Investigations, Cell Phone and Mobile Device
6. Forensics Tools & Techniques: SNORT, Wireshark, TCP Dump, Nexus, RegEdit, Process Monitor.

PROGRAM ELECTIVE - V

P18PECS051	MOBILE COMMUNICATION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks, TCP/IP Principles and Architectures.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To understand the basics of Mobile computing and Personal computing.
- To learn the role of wireless networks in Mobile Computing and Pervasive Computing.
- To study about the underlying wireless networks.
- To understand the architectures of mobile and pervasive applications.
- To become familiar with the pervasive devices and mobile computing platforms.

COURSE OUTCOMES (COs)

CO1	Students can able to deploy 3G networks.
CO2	To develop suitable algorithms for 4G networks.
CO3	To use sensor and mesh networks to develop mobile computing environment.
CO4	To develop mobile computing applications based on the paradigm of context aware Computing.
CO5	To develop 3 Tier Architecture.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS051 Mobile and Pervasive Computing	M	H	M	H	M	M	-	-	H	M	M

UNIT I INTRODUCTION 9

Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards- Signal propagation: Propagation mechanism reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing Multiple access schemes: FDMA, TDMA, CDMA and SDMA.

UNIT II 3G AND 4G CELLULAR NETWORKS 9

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP.

UNIT III SENSOR AND MESH NETWORKS 9

Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination –Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks– Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks

UNIT IV CONTEXT AWARE COMPUTING 9

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis– Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware –Adaptation and Agents – Service Discovery Middleware

UNIT V APPLICATION DEVELOPMENT 9

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME –Programming for CLDC – GUI in MIDP – Application Development on Android and iPhone.

TOTAL NO.OF PERIODS: 45

TEXT BOOKS:

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applications and Service Creation", Second Edition, Tata McGraw Hill, 2010.
2. Reto Meier, "Professional Android 2 Application Development", Wrox Wiley, 2010.
3. Pei Zheng and Lionel M Li, "Smart Phone & Next Generation Mobile Computing", MorganKaufmann Publishers, 2006.

REFERENCE BOOKS:

1. Reto Meier, "Professional Android 2 Application Development", Wrox Wiley, 2010.
2. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", Wiley,2009.
3. Frank Adelstein, ''Fundamentals of Mobile and Pervasive Computing", TMH, 2005.
4. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufmann Publishers,2004.
5. Jochen Burthardt et al, "Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson Education, 2003.
6. Uwe Hansmaan et al, "Principles of Mobile Computing", Springer, 2003.

P18PECS052	COMPILER FOR HPC	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Data Structure, Compiler Design, Theory of Computation.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

The objective of this course is to introduce structure of compilers and high performance comp design for students. Concepts of cache coherence and parallel loops in compilers are included.

COURSE OUTCOMES (COs)

CO1	Familiar with the structure of compiler.
CO2	Learn Scalar Analysis With Factored Use-Def Chains
CO3	Parallel loops, data dependency and exception handling and debugging in compiler.
CO4	Understand Concurrency Analysis and Vector Analysis
CO5	Learn Message-passing machines and scalable shared-memory machines.

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	M	M	H	M	M	M		M			
	CO2			H	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	H	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS052 Compiler for HPC	M	H	H	H	M	M	-	-	H	M	M

UNIT I INTRODUCTION & DATA DEPENDENCE 9

INTODUCTION: High Performance Systems**,** Structure of a Compiler, Programming LanguageFeatures, Languages for High Performance.

DATA DEPENDENCE: Data Dependence in Loops, Data Dependence inConditionals, Data Dependence in Parallel Loops, Program Dependence Graph.

UNIT II SCALAR ANALYSIS WITH FACTORED USE-DEF CHAINS 9

Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains,Constant Propagation with FUD Chains, Data Dependence for Scalars, DataDependence Analysis for Arrays, Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls,

Inter-procedural Analysis.

UNIT III LOOP RESTRUCTURING & OPTIMIZING FOR LOCALITY 9

LOOP RESTRUCTURING: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

OPTIMIZING FOR LOCALITY: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

UNIT IV CONCURRENCY ANALYSIS AND VECTOR ANALYSIS 9

CONCURRENCY ANALYSIS: Concurrency from Sequential Loops, Concurrency fromParallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

VECTOR ANALYSIS: Vector Code, Vector Code from Sequential Loops, VectorCode from For all Loops, Nested Loops, Round off Error, Exceptions, andDebuggers, Multi-vector Computers.

UNIT V RECENT TRENDS 9

MESSAGE-PASSING MACHINES: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

SCALABLE SHARED-MEMORY MACHINES: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines. Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

TOTAL NO OF PERIODS: 45

TEXT BOOK:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

REFERENCE:

1. https://hpcugent.github.io/vsc_user_docs/pdf/intro-HPC-mac-gent.pdf

P18PECS053	**OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Linear Algebra and Numerical Methods.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To provide insight to the mathematical formulation of real world problems.
- To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

COURSE OUTCOMES (COs)

CO1	Formulate optimization problems.
CO2	Understand and apply the concept of optimality criteria for various types of optimization problems.
CO3	Solve various constrained and unconstrained problems in Single variable as well as multivariable.
CO4	Apply the methods of optimization in real life situation.
CO5	Learn various Recent trends in Optimization techniques.

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			M	M	M		M		M
	CO2	H	M	M							M	
	CO3	H	H		M				M			M
	CO4	H	H			M	M	M		M	M	M
	CO5	H	M									H
3	Category	Program Elective (PE)										

4	Approval	Meeting of Academic Council, 2018

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS053 Optimization Techniques	H	M	-	-	M	M	-	-	H	-	M

UNITI INTRODUCTION **9**

Engineering application of Optimization, Formulation of design problems as mathematical programming problems. General Structure of Optimization Algorithms, Constraints, The Feasible Region.

UNIT II MATHEMATICAL PROGRAMMING **9**

Branches of Mathematical Programming: Optimization using calculus, GraphicalOptimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

UNIT III OPTIMIZATION ALGORITHMS **9**

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

UNIT IV REAL LIFE PROBLEMS **9**

Real life Problems and their mathematical formulation as standard programming problems.

UNIT V RECENT TRENDS **9**

Recent trends: Applications of ant colony optimization, genetics and linear andquadratic programming in real world applications.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Laurence A. Wolsey (1998). Integer programming.Wiley.ISBN 978-0-471-28366-9.

2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.

3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.

4. Dimitris Bertsimas; Robert Weismantel (2005).Optimization over integers.Dynamic Ideas. ISBN 978-0-9759146-2-5.

REFERENCES:

1. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
2. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279
3. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank;
4. Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer.ISBN 978-3-540-68274-5.
5. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling andSolution. John Wiley and Sons. ISBN 978-0-470-37306-4.

PROGRAM ELECTIVE V- LAB

P18PECS051L1	MOBILE COMMUNICATION LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Computer Networks, TCP/IP Principles and Architectures.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To understand the basics of Mobile computing and Personal computing.
- To learn the role of wireless networks in Mobile Computing and Pervasive Computing.
- To study about the underlying wireless networks.
- To understand the architectures of mobile and pervasive applications.
- To become familiar with the pervasive devices and mobile computing platforms.

COURSE OUTCOMES (COs)

CO1	Students can able to deploy 3G networks.
CO2	To develop suitable algorithms for 4G networks.
CO3	To use sensor and mesh networks to develop mobile computing environment.
CO4	To develop mobile computing applications based on the paradigm of context aware Computing.
CO5	To develop 3 Tier Architecture.

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	M	M	H	M	M	M		M			
	CO2			M	M	H				M	H	
	CO3	M	M	M		M	M	M	M		M	M
	CO4	M			M							
	CO5		H	M	H	M	M		M	M	M	M
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS051L1 Mobile Communication Lab	M	H	M	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1. Embedded wireless solutions using CDMA network.

2. GPS integrated GSM modules using SMS for in tracking & remote monitoring applications

3. Embedded GPS modules interfaced with other embedded modules for location based applications.

4. GPS integrated GSM modules using SMS for in tracking & remote monitoring applications
5 Developing GSM board+ SIM card based applications emulating mobile phones.

6. SMS based remote monitoring/control applications using existing GSM network.

7. Bluetooth based wireless personal area networking (WPAN) – printers, mouse, keypads, and mobiles.
8. Combining RFID and Bluetooth.

9. Mobile Communication Trainer MT2000 development kit in 49 MHz ISM Band.

10. RFID Development Kit.

P18PECS052L1	**COMPILER FOR HPC LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Data Structure, Compiler Design, Theory of Computation.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- The objective of this course is to introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

COURSE OUTCOMES (COs)

CO1	Familiar with the structure of compiler.
CO2	Learn Scalar Analysis With Factored Use-Def Chains
CO3	Parallel loops, data dependency and exception handling and debugging in compiler.
CO4	Understand Concurrency Analysis and Vector Analysis
CO5	Learn Message-passing machines and scalable shared-memory machines.

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	H	H				M			M
	CO2			M	M					L		
	CO3	H	M			M	M	H	M		M	
	CO4	M			M							
	CO5		M	H		M			L	M		L
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS052L1 Compiler for HPC Lab	M	H	H	H	M	M	-	-	H	M	M

LIST OF EXPERIMENTS

1. Perform concurrent ODD-Even Merge sort using HPC infrastructure using Python/ Java/ C++.

2. Implement OBST Tree search using HPC task sub-division. Merge the results to get final result.

3. Create a backtracking scenario and use HPC architecture.

4. Using Divide and Conquer Strategies design a class for Concurrent Quick Sort using C++.

5. Write a MPI program for calculating a quantity called coverage from data files.

6. Build a small compute cluster using Raspberry Pi/BBB modules to implement Booths Multiplication algorithm.

7. Write a mobile application to generate a Scientific calculator using J2ME/ Python/ Scala/ C++/ Android.

8. Build a shopping centre database containing items for sale.

9. Select an Industrial sector and write a BAI tool for maximizing the profit.

10. Build a small compute cluster using Raspberry Pi/BBB modules to implement Booths Multiplication algorithm.

P18PECS053L1	OPTIMIZATION TECHNIQUES LAB	L	T	P	C
	Total Contact Hours: 30	0	0	4	2
	Prerequisite: Linear Algebra and Numerical Methods.				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

- To provide insight to the mathematical formulation of real world problems.
- To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

COURSE OUTCOMES (COs)

CO1	Formulate optimization problems.
CO2	Understand and apply the concept of optimality criteria for various types of optimization problems.
CO3	Solve various constrained and unconstrained problems in Single variable as well as multivariable.
CO4	Apply the methods of optimization in real life situation.
CO5	Learn various Recent trends in Optimization techniques.

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			M	M	M		M		M
	CO2	H	M	M							M	
	CO3	H	H		M				M			M
	CO4	H	H			M	M	M		M	M	M
	CO5	H	M									H
3	Category	Program Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18PECS053L1 Optimization Techniques Lab	H	M	-	-	M	-	M	-	H	-	L

LIST OF EXPERIMENTS

1.Write a program to implement Hill Climbing algorithm**.**

2. Write a program to implement Linear Programming.

3. Write a program to implement Simulated Annealing.

4. Write a program to implement Genetic algorithms.

5. To implement Ant colony optimization.

6. Write a program to implement Dynamic Programming.

7. Write a program to implement Stochastic Programming.

8. Write a program to implement Quadratic Programming.

9. Write a program to implement Integer Programming.

10. Write a program to implement Constraint satisfaction.

OPEN ELECTIVE-I

P18OECS001	BUSINESS ANALYTICS	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 main objective of this course is to give the student a comprehensive understanding of business analytics methods.

COURSE OUTCOMES (COs)

CO1	Learn Business analysis and life cycles
CO2	Understand Forming requirements and Documents
CO3	Learn various Transforming requirements and Modelling
CO4	Understand about Finalizing requirements and Change control
CO5	Learn various Recent technologies in business intelligence.

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	M	M			M	M	M	H	M		M
	CO2			M						H	H	
	CO3	M			L				M			
	CO4		M			M	M	M		M	M	M
	CO5		M	M				M	H		H	M
3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OECS001 Business Analytics	M	M	-	-	H	-	M	H	H	H	M

UNIT 1 BUSINESS ANALYSIS AND LIFE CYCLES **9**

Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts. Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT 2 FORMING REQUIREMENTS **9**

Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

UNIT 3 TRANSFORMING REQUIREMENTS **9**

Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT 4 FINALIZING REQUIREMENTS **9**

Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools.

UNIT 5 RECENT TRENDS **9**

Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

TOTAL NO OF PERIODS: 45

REFERENCES:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray.

P18OEMA002	OPERATIONS RESEARCH	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Mathematics				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

Able to have knowledge of various operations Research techniques.

COURSE OUTCOMES (COs)

CO1	Should able to apply the dynamic programming to solve problems of discreet and continuous variables.
CO2	Students should able to apply the concept of non-linear programming
CO3	Students should able to carry out sensitivity analysis.
CO4	Student should able to model the real world problem and simulate it.
CO5	Understand Competitive Models, Single and Multi-channel Problems.

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			M	M	M		M		M
	CO2	H	M	M							M	
	CO3	H	H		M				M			M
	CO4	H	H			M	M	M		M	M	M
	CO5	H	M									H
3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OEMA002 Operations Research	H	H	-	M	M	M	-	M	M	-	M

UNIT 1 OPTIMIZATION TECHNIQUES 9

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT 2 DUALITY THEORY 9

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT 3 PERT AND CPM 9

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT 4 SCHEDULING AND SEQUENCING 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT 5 GRAPH THEORY 9

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

TOTAL NO OF PERIODS: 45

REFERENCES:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008

P18OEME003	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

Able to have knowledge of various Industrial safety techniques

COURSE OUTCOMES (COs)

CO1	Learn Accident, causes, types, results and control, mechanical and electrical hazards.
CO2	Understand Maintenance cost & its relation with replacement economy, Service life of equipment.
CO3	Learn Wear and Corrosion And Their Prevention
CO4	Able to Understand Fault tracing-concept and importance, decision tree concept
CO5	Understand Periodic inspection and repairing schemes.

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	M	M	M			M		H			M
	CO2				M					H		
	CO3		L	H		M	M	H	H		H	M
	CO4	M			M			M				
	CO5		M	M		M			M	M	M	L

3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												
	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OEME003 Industrial Safety	M	-	M	-	M	-	H	M	M	-	M

UNIT-I INDUSTRIAL SAFETY 9

Accident, causes, types, results and control, mechanical and electrical hazards, 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 9

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 9

Wear- types, causes, effects, wear reduction methods, 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 9

Fault tracing-concept and importance, decision tree concept, need and applications, 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 9

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

TOTAL NO OF PERIODS: 45

REFERENCES:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Accounting				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

Able to have knowledge of Cost Management of Engineering projects.

COURSE OUTCOMES (COs)

CO1	Comprehensive understanding of cost management methods.
CO2	Learn about project scheduling and execution.
CO3	Understand Cost Behavior and Profit Planning Marginal Costing
CO4	Learn Total Quality Management and Theory of constraints.
CO5	Learn Linear Programming, PERT/CPM.

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			M	M	M		M		M
	CO2	H	M	M							M	
	CO3	H	H		M				M			M
	CO4	H	H			M	M	M		M	M	M
	CO5	H	M									H
3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OEBA004 Cost Management of Engineering Projects	H	H	-	M	M	M	-	M	M	-	M

UNIT 1 INTRODUCTION **9**

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT 2 PROJECT **9**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT III COST BEHAVIOR AND PROFIT PLANNING **9**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.

UNIT IV TOTAL QUALITY MANAGEMENT **9**

Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V PERT/CPM **9**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TOTAL NO OF PERIODS: 45

REFERENCES:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Mechanical Engineering				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

After completion of course, students would be able to have knowledge about composite materials.

COURSE OUTCOMES (COs)

CO1	Learn Classification and characteristics of Composite materials
CO2	Understand reinforcements and Properties.
CO3	Study about Manufacturing Of Metal Matrix Composites.
CO4	Study about Manufacturing Of Polymer Matrix Composites.
CO5	Understand Laminar Failure Criteria-strength ratio, maximum stress criteria.

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	M	M	M			M		H			M
	CO2				M					H		
	CO3		L	H		M	M	H	H		H	M
	CO4	M			M			M				
	CO5		M	M		M			M	M	M	L
3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OEME005 Composite Materials	M	-	M	-	M	-	H	M	M	M	-

UNIT–I INTRODUCTION **9**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II REINFORCEMENTS **9**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III MANUFACTURING OF METAL MATRIX COMPOSITES **9**

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV MANUFACTURING OF POLYMER MATRIX COMPOSITES **9**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V STRENGTH **9**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL NO OF PERIODS: 45

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications–Danial Gay, Suong V. Hoa,Stephen, W. Tasi.

P18OEME005	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Environmental Studies				
	Course Designed by : Dept. of Computer Science and Engineering				

OBJECTIVES

After completion of course, students would be able to have knowledge about waste to Energy

COURSE OUTCOMES (COs)	
CO1	Learn various Industrial waste and Fuel
CO2	Understand Biomass Pyrolysis and Applications
CO3	Learn about biomass gasification
CO4	Study about Biomass Combustion techniques
CO5	Learn Properties of biogas ,Biogas plant technology and status

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	M	M	M			M		H			M
	CO2				M					H		
	CO3		L	H		M	M	H	H		H	M
	CO4	M			M			M				
	CO5		M	M		M			M	M	M	L
3	Category	Open Elective (PE)										
4	Approval	Meeting of Academic Council, 2018										

Mapping of Course with Student Outcomes (SOs)

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

	Name of the Course	a	b	c	d	e	f	g	h	i	j	K
	P18OEME005 Waste to Energy	M	-	M	-	M	-	H	M	M	M	-

UNIT-I INTRODUCTION TO ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT-II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V BIOGAS 9

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL NO OF PERIODS: 45

REFERENCES:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons.

CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

M.Tech – APPLIED ELECTRONICS
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PEAE011	PE	Hardware and software Co-design	3	3	0	0	3
2	P18PCAE101	PC	Logic System Design and Verification	3	3	0	0	3
3		PE	Professional Elective – 1	3	3	0	0	3
4		PE	Professional Elective – 2	3	3	0	0	3
5	P18PRAE103	PR	Research Methodology and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
7	P18PCAE1L1	PC	Advanced Electronics system design lab	4	0	0	4	2
8	P18PCAE1L2	PC	Embedded system design Lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCAE201	PC	Advanced Analog Integrated Circuits	3	3	0	0	3
2	P18PCAE202	PC	Non Linear Signal	3	3	0	0	3

			Processing					
3		PE	Professional Elective – 3	3	3	0	0	3
4		PE	Professional Elective – 4	3	3	0	0	3
5		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCAE2L1	PC	Signal Processing lab	4	0	0	4	2
7	P18PCAE2L2	PC	Integrated Circuit design Laboratory	4	0	0	4	2
8	P18PRAE2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective – 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRAE3P2	PR	Phase – I Dissertation	20	0	0	20	10
			Total	26	6	0	20	16

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRAE4P3	PR	Phase-II Dissertation	32	0	0	32	16
			Total	32	0	0	32	16

TOTAL CREDIT = 18+18+16+16= 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PCMA106	PC	Advanced Mathematics for Electronics Engineers	3	3	0	0	3
2	P18PEAE012	PE	Microcontroller for embedded system design	3	3	0	0	3
3	P18PEAE013	PE	Advanced digital image processing	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEAE021	PE	Advanced Computer Architecture design	3	3	0	0	3
2	P18PEAE022	PE	Modeling and simulation of communication networks	3	3	0	0	3
3	P18PEAE023	PE	Advanced Digital Control System	3	3	0	0	3

PROFESSIONAL ELECTIVE – 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEAE031	PE	Multidimensional Image Processing	3	3	0	0	3
2	P18PEAE032	PE	Advanced Cryptography and data security	3	3	0	0	3
3	P18PEAE033	PE	Intelligent Computing Techniques	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEAE041	PE	DSP Integrated systems	3	3	0	0	3
2	P18PEAE042	PE	Low power VLSI Design	3	3	0	0	3
3	P18PEAE043	PE	Real Time Operating system design	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEAE051	PE	Electromagnetic Interference and Compatibility in System Design	3	3	0	0	3
2	P18PEAE052	PE	Advanced Robotics and Automation	3	3	0	0	3
3	P18PEAE053	PE	Advanced Wireless Communication	3	3	0	0	3

OPEN ELECTIVE

S.No	**Code No.**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3		0	0	3

Audit I& Audit II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18ACEN001	AC	English for Research Paper	2	2	0	0	0
2	P18ACCE002	AC	Disaster Management	2	2	0	0	0
3	P18ACEN003	AC	Sanskrit for Technical	2	2	0	0	0
4	P18ACBA004	AC	Value Education	2	2	0	0	0
5	P18ACLW005	AC	Constitution of India	2	2	0	0	0
6	P18ACBA006	AC	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	AC	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	AC	Personality Development	2	2	0	0	0

SEMESTER I

P18PEAE011	**HARDWARE – SOFTWARE CO-DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Linear Integration Circuits				
	Course Designed by – Dept. of Electronics And Communication Engineering				

Objectives:

- To acquire the knowledge about system specification and modeling.
- To learn the formulation of partitioning
- To analyze about co-synthesis.
- To study the different technical aspects about prototyping and emulation.
- To formulate the design specification and validate its functionality by simulation.

SYLLABUS

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modelling , Co-Design for Heterogeneous Implementation – Processor Synthe Single-Processor Architectures with one ASIC, Single-Processor Architectures with many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation ,Requirements for Embedded System Specification.

UNIT II HARDWARE/SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem , Optimization , HW /SW Partitioning based on Heuristic Scheduling, HW /SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments,Future Developments in Emulation and Prototyping ,Target Architecture- Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TEXT BOOK:

1.RalfNiemann , “Hardware/Software Co-Design for Data Flow Dominated Embedded

Systems", Kluwer Academic Pub, 1998.

REFERENCES:

1.JorgenStaunstrup, Wayne W olf ,"Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub,1997.

2.Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design" Kaufmann Publishers,2001.

COURSE OUTCOME At the end of the course students will be able to	
CO1	Understand the concepts of system specification and modeling.
CO2	Analyze the formulation of Partitioning.
CO3	Analyze and implement the Co-synthesis.
CO4	Understand the prototyping and Emulation techniques
CO5	Acquire the knowledge of design specification and verification
CO6	Analyze the hardware and software partitioning ,co –synthesis and design specification

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H	M	M			M	L	M	M
	CO2	M	H	H	M	M			L	L	M	M
	CO3	M	H	H	L	M			M	L	L	M
	CO4	M	H	H	M	M			L	M	M	L
	CO5	H	M	M	L	M			L	M	L	M
	CO6	M	M	M	L	M			L	M	L	L
3	Category	PC										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PCAE101	**LOGIC SYSTEM DESIGN AND VERIFICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

The Course aims at covering the important problems/algorithms/tools so that students get a comprehensive idea of the whole digital design flow.

SYLLABUS

UNIT I : INTRODUCTION 9

Introduction to Digital VLSI Design Flow-: High Level Design Representation-Transformations for High Level Synthesis-Introduction to HLS:Scheduling,Allocation and Binding Problem-Scheduling Algorithms-Binding and Allocation Algorithms

UNIT II : LOGIC OPTIMIZATION AND SYNTHESIS 9

Two level Boolean Logic Synthesis-Heuristic Minimization of Two-Level Circuits-: Finite State Machine Synthesis-Multilevel Implementation

UNIT III : VERIFICATION 9

Introduction to formal methods for verification-Temporal Logic: Introduction and Basic OperatorsSyntax and Semantics of CTL-Equivalence between CTLFormulasBinary Decision Diagram: Introduction and construction Lecture-II: Ordered Binary Decision Diagram Lecture-III: Operations on Ordered Binary Decision Diagram Lecture-IV: Ordered Binary Decision Diagram for Sequential CircuitsSymbolic Model Checking

UNIT IV DIGITAL TESTING 9

Introduction to Digital VLSI Testing - Functional and Structural Testing - Fault Equivalence - Fault Simulation and Testability Measures - Fault Simulation - Testability Measures (SCOAP)

UNIT V COMBINATIONAL CIRCUIT TESTING AND SEQUENTIAL CIRCUIT TESTING 9

Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras -D-Algorithm Sequential Circuit Testing and Scan Chains - ATPG for Synchronous Sequential Circuits- Scan Chain based Sequential Circuit Testing - Built in Self test (BIST) - Memory Testing

Text Book:

1. D. D. Gajski, N. D. Dutt,A.C.-H. Wu and S.Y.-L. Lin, High-Level Synthesis: Introduction to Chip and System Design,Springer, 1st edition, 1992.
2. S.Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis,Prentice Hall, 2nd edition, 2003.

References:

1. G. De Micheli.Synthesis and optimization of digital circuits, 1st edition, 1994.
2. M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning about systems, Cambridge University Press, 2nd Edition, 2004
3. Bushnell and Agrawal,Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits,Kluwer Academic Publishers, 2000

COURSE OUTCOMES (COs)

CO1	To learn the VLSI Design flow
CO2	To understand about the optimization concepts.
CO3	To learn about verification concepts.
CO4	To gain knowledge about the basics of Testing
CO5	To learn about testing of combinational circuits
CO6	To learn about testing of 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			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
3	Category	Professional Core										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PRAE103	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	2	0	0	2
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics And Communication Engineering				

Objectives:

Student will understand research problem formulation and Analyze research related information

SYLLABUS

Unit 1: Meaning of research problem, Sources of research problem, CriteriaCharacteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysisPlagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer oftechnology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. Newdevelopments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested reading

1.Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

CO1	To understand the Approaches of investigation of solutions for research problem											
CO2	Students to analysis Plagiarism											
CO3	To able to understand the Effective technical writing											
CO4	Nature of Intellectual Property											
CO5	Understand the concept of Patent Rights											
CO6	To gain knowledge in New Developments in IPR											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L 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	M	H	H		H						H
	CO2	M	H	H		H						L
	CO3	M				M			H			L
	CO4	M	H	L		H			M			H
	CO5	M		M		M			L			
	CO6	M				L			H	M		
3	Category	PROFESSIONAL CORE COURSES (PCC)										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PCAE1L1	**ADVANCED ELECTRONICS SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – ELECTRONICS SYSTEM DESIGN				
	Course Designed by – Dept. of Electronics And Communication Engineering				

Objectives:

To design digital circuits using Hardware Description languages and to learn about SPICE Simulation

(EXPERIMENTS FROM 1 TO 6 SHOULD BE DONE USING VERILOG VHDL ON FPGA)

1. DESIGN AND TESTING OF HALF ADDER, FULL ADDER.
2. DESIGN AND TESTING OF HALF SRACTOR/FULL SUBTRACTOR.
3. DESIGN AND TESTING OF JK, D, T, SR FLIPFLOPS.
4. DESIGN AND TESTING OF COUNTERS.
5. DESIGN AND TESTING OF MULTIPLEXER, DEMULTIPLEXER.
6. DESIGN AND TESTING OF MAGNITUDE COMPARATOR WITH 8 BITS.
7. DESIGN AND TESTING OF ELECTRONICS CIRCUITS USING SPICE SIMULATION (HARTELY OSCILATOR /COLPITTS OSCILATOR AND RC-COUPLEDAMPLIFIER)
8. SCHEMATIC CAPTURE & PCB LAYOUT DESIGN USING EDA TOOLS LIKE ORCAD.

CO1	Design and test digital logic circuits on FPGA.
CO2	Design Electronic circuits using SPICE and PCB layout using EDA tools
CO3	To learn about the design of digital circuits of MULTIPLEXER, DEMULTIPLEXER us Hardware description languages
CO4	To learn about the design of digital circuits of ENCODER, DECODER using Hardw description languages
CO5	To learn about the design of digital circuits of JK, D, T, SR FLIPFLOPS
CO6	To learn about the design of Oscillators using PSPICE

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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		L	H	M	M	M
	CO2	H	H	H	M	M		L	H	M	M	M
	CO3	M	H	H	M	L		M	H	M	M	M
	CO4	M	H	H	M	L		L	H	M	M	L
	CO5	M	H	H	M	L		L	H	L	M	L
	CO6	L	H	H	H	M		M	M	H	M	M
3	Category	PROFESSIONAL CORE COURSES (PCC)										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PCAE1L2	**EMBEDDED SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Embedded Systems				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

- Understand the problem to be solved by incorporating PIC microcontroller.
- Identify the appropriate interfacing device for the problem.
- Design and execution of interfacing circuits.
- Practice simple programming in PIC.
- Experiment with peripheral devices on the PIC evaluation kit.

LIST OF EXPERIMENTS

1. ADC Interface Experiment with Temperature Sensor.
2. Stepper Motor Interface.
3. Traffic Light Controller.
4. DAC/DC Motor Speed Control.
5. IC to PC Serial (RS232) Communication.

SEMESTER II

P18PCAE201	**ADVANCED ANALOG INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Linear Integration Circuits				
	Course Designed by – Dept. of Electronics And Communication Engineering				

Objectives:

To design the single stage amplifiers using PMOS and NMOS driver circuits with different loads and To analyze high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers

SYLLABUS

UNIT-I CIRCUIT CONFIGURATION FOR LINEAR IC 9

Current source, analysis of difference amplifiers with active load, Supply and temperature independent biasing techniques, voltage references.

UNIT-II OPERATIONAL AMPLIFIERS 9

Analysis of operational amplifier circuits, slew rate model and high frequency analysis, operational amplifier noise analysis and low noise operational amplifiers.

UNIT-III ANALOG MULTIPLIER AND PLL 9

Analysis of MOS operational Amplifier, CMOS voltage references, MOS Power amplifier and analog switches.

UNIT-IV MOS ANALOG ICS 9

Design of MOS Operational Amplifier,CMOS Voltage references,MOS power amplifier and analog switches.

UNIT-V MOS SWITCHED CAPACITOR FILTERS 9

Design techniques for switched capacitor filter, CMOS switched capacitor filters, MOS integrated active RC filters.

TEXT BOOK:

1.KennethR.Laker, Willy M.C.Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems ", McGraw Hill, 1994.
2.BehzadRazavi, "Principles of Data Conversion System Design", S.Chand&Company ltd, 2000.

REFERENCES BOOK:

1.Gray and Meyer, "Analysis and Design of Analog IC's, Wiley International, 1996.
2.Gray, Wooley, Broderson, "Analog MOS Integrated Circuits", IEEE Press 1989.

CO1	Ability to analyze the design of single and two stage operational amplifiers and voltage references, and determine the device dimensions of each MOSFETs involved.
CO2	To understand the design techniques of switched capacitor filters
CO3	To study the different types of current mirrors
CO4	To know the concepts of voltage and current reference circuits
CO5	To understand about MOS switched capacitor filters.
CO6	Students will demonstrate their knowledge by designing analog 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	M	M	H	H	M		L	M	M	L	M
	CO2	M	H	H	M	M		M	M	M	L	M
	CO3	L	L	M	L	M		M	L	M	L	L
	CO4	L	M	M	L	M		M	H	M	L	L
	CO5	M	H	H	M	L		M	M	M	L	L
	CO6	M	H	H	M	L		M	L	M	M	M
3	Category	PC										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PCAE202	**NON – LINEAR SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital signal processing				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- The student understands Maximum Likelihood estimation, point and scale estimation.
- The student is familiar with binary and color image processing basics.
- The student can handle median based operations.
- The student has knowledge about sorting operations.
- The student can explain various implementation technologies.

SYLLABUS

UNIT ILINEAR SIGNAL PROCESSING AND STATISTICAL PRELIMINARIES 9

Random Variables and Distributions – Estimation – Point Estimation – Maximum likelihood Estimators – M-Estimators – L-Estimators – R-Estimators – Scale Estimation - Noise Models.

UNIT II BINARY IMAGE AND COLOUR IMAGE PROCESSING 9

Introduction – Morphological Image Processing –Standard Binary morphological operations – Dilation and Erosion based operations. Introduction to colour image processing – Light and colour – Colour formation – Human perception of colour – Colour Model – the Chromaticity Diagram – Colour image Quantization – Histogram of a Colour image – Colour image Filtering – Pseudo-Colouring – colour image segmentation.

UNIT III INTRODUCTION TO NON LINEAR FILTERS 9

Nonlinear filters – Measures of robustness – Order Statistics Filters – Median filters and their characteristics – Impulse noise filtering by median filters – Recursive and weighted median filters –Decision based filters – Switched Median filters.

UNIT IV ALGORITHMS 9

Sorting and Selection Algorithm – Running Median Algorithm – Bitonic sort – Bubble sort and its variant – Shellsort – Quick sort – Bucket and Sample sort – Enumeration sort and Radix sort.

UNIT V ARCHITECTURE AND APPLICATIONS OF NONLINEAR FILTERS 9

Basic structure for order statistics filtering – Systolic array implementation – Wavefront array implementation – General nonlinear filter structure – Signal dependent noise filtering – Computational complexity of general nonlinear filter model – Nonlinear Edge Detection – Implementation of decision logics.

TEXT BOOKS:

1. 1 Gonzalo R. Arce,"Nonlinear Signal Processing: A Statistical Approach", Wiley-Interscience, 2004.
2. S. K Mitra, "Nonlinear Image Processing ", Academic Press, 2000.

REFERENCES

1. Loannis Pitas, Anastasios N. Venetsanopoulos,"Nonlinear digital filters: principles and applications", Springer, 1990 – Technology & Engineering.

COURSE OUTCOMES (COs)	
CO1	Derive Maximum Likelihood criterion in the least square sense.
CO2	Define the rules and standards for binary
CO3	Describe different sorting algorithms.
CO4	Design simple median based filters.
CO5	Develop different architecture schemes for nonlinear filters.
CO6	Define the rules and standards for color image processing
	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	l
2	CO1		H				M						
	CO2	M			H	M				M			
	CO3		M									L	
	CO4	L							L				
	CO5			L	M			M			M		M
	CO6												
3	Category		PC										
4	Approval		47th Meetings of Academic Council, Aug, 2018										

P18PCAE2L3	**SIGNAL PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours -30	0	0	4	2
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To simulate and analyze various image processing and compression algorithms.

LIST OF EXPERIMENTS

1. Simulation of Low Pass Filtering
2. Simulation of Interference Suppression
3. Simulation of Edge detection using Sobel operator
4. Simulation of Point detection
5. Simulation of Line detection
6. Simulation of Linear and Circular convolution
7. Simulation of Discrete Fourier Transform
8. Simulation of Discrete Cosine Transform
9. Simulation of Image compression using JPEG standard

COURSE OUTCOMES (COs)	
CO1	At the end of the course student will be able to perform analysis of image processing algorithms using simulation tools.
CO2	Student will be able to Simulate the Interference Suppression.
CO3	Able to understand and implement the Simulation of Point & line detection.
CO4	To understand and implement the Simulation of Linear and Circular convolution
CO5	Student will be able to Simulate DFT & DCT.
CO6	To understand and implement the Simulation of Image compression using JPEG standard.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H	M	H			M	M	L	H
	CO2	M	H	H	M	M			L	M	L	M
	CO3	M	H	H	M	M			L	M	L	M
	CO4	M	M	H	H	M			L	M	L	M
	CO5	M	H	M	H	M			M	H	M	H
	CO6	H	M	M	M	M			L	M	L	M
3	Category	Professional Core										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PCAE2L4	**INTEGRATED CIRCUIT DESIGNLABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours –30	0	0	4	2
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To learn about

- Simulation, synthesis and implementation of digital circuits using HDLs;
- Modeling and simulation of analog circuits using SPICE.

Modeling and simulation of Analog Circuits using SPICE :

1. Design and verification of Current Mirror Circuits .
2. Design and verification of Differential Amplifiers.
3. Design and verification of internal Circuit of OP-AMP
4. Design and verification of Switched Capacitor Integrator

Modeling and Functional Simulation of the following digital circuits using VHDL/Verilog Hardware Description Languages

1. Logic Gates,
2. Adders
3. Encoders and decoders,
4. Multiplexer and Demultiplexer
5. Comparator
6. Multipliers
7. Flip-Flops
8. Registers
9. Counters,
10. Finite State Machine

COURSE OUTCOMES (COs)	
CO1	Demonstrate skills in SPICE Coding and verification of analog circuits
CO2	Conceptualize and solve problems in logic verification and timing calculation of Digital circuits.
CO3	Acquire research skills in the domain of Digital Systems
CO4	Create, develop and use modern tools to analyze problems of RTL, Technology schematic, and system implementations
CO5	Contribute positively to multidisciplinary scientific research in design and developmen Integrated Circuits suited for wide range of applications
CO6	Perform experiments efficiently in Digital system design to achieve optimization for high device utilization and performance in industrial needs

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L 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	H	M			M	M	M	H
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	H	H	M			M		M	H
	CO4	H	H	H	M	H				H		H
	CO5	H	H	H	H	H			M	M	M	
	CO6	M	H	H	H	H			H	H	M	H
3	Category	Professional Core										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

ELECTIVES

	ADVANCED MATHEMATICS FOR ELECTRONICS ENGINEERS	**L**	**T**	**P**	**C**
P18PCMA106	Total Contact Hours:45	3	1	0	3
	Prerequisite:NIL				
	Course Designed by : Dept of Mathematics				

OBJECTIVES

To apply all taught techniques to unseen problems, and queuing is a major branch of optimization, Random variable compute and interpret means, correlation/covariance, PERT and CPM chart is mainly used for documenting the data(visually) on projects.

SYLLABUS

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 9

Random variables and their functions - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Exponential, Gamma, Weibull and Normal distributions.

UNIT II MATRIX THEORY 9

Eigen values using QR Transformations generalized eigenvectors – Canonical forms, singular valued composition and application – matrix norms and induced norms Psuedo inverse – least square approximations

UNIT III SPECIAL FUNCTIONS 9

Bessel's Equation- Bessel Functions- Legendre's Equation- Legendre Polynomials- Rodrigue's Formula- Recurrence Relations- Generating Functions and Orthogonal Property for Bessel Function of the First Kind.

UNIT IV OPERATIONS RESEARCH 9

Network Definitions – Minimal Spanning Tree algorithm – Shortest Route Problem – Maximal Flow model – Minimum Cost Capacitated Flow Problem – CPM and PERT.

UNIT V QUEUING THEORY 9

Single and Multiple Server Markovain Queuing Models – Customer Impatience Priority Queues M/g / I Queuing System –Queuing Applications.

TEXT BOOKS:

1. Handy A.Taha., "Operations Research An Introduction", 7th Edn. Pearson Education , Chennai-113. 2002.
2. Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 2nd Edn.
3. Wiley India Pvt Ltd, New Delhi.

R**EFERENCE BOOKS:**

1. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi. 1994.
2. Gupta.SC and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.
3. Stewart G.W. "Introduction to Matrix Computaions" Academic Press, New York.

COURSE OUTCOMES (COs)	
CO1	The student will learn to analyse and solve the fundamental problems with prescribed conditions in simple cases.
CO2	The student will learn to understand how signals, systems, inference combine in prototypical tasks of communication.
CO3	The student will learn to manipulate matrices and to do matrix algebra, determinants, eigen values Eigen vectors and to solve the system of linear equations.
CO4	The student will learn to understand how signals, systems, control.
CO5	The student will learn to understand how signals, systems, signal processing.
CO6	Thestudent will learn operation research methodology.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			H	H		H
	CO2	H	H	M	H	H			H	H	M	H
	CO3	H	M	H	H	H			M	H	H	H

	CO4	H	M		M							
	CO5	H	H	M	H				M	M	M	
	CO6	H	M	M	H	H			H	M		
3	Category	Professional Core (PC)										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE012	**MICROCONTROLLER FOR EMBEDDED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Networks				
	Course Designed by : Dept. of Electronics and Communication Engineering				

OBJECTIVES

The main objective of this course is to provide the student with the basic understanding of embedded systems design. This includes system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications. Learning the concepts will be enforced by a Project to design and develop an embedded system based on a single-chip microcontroller.

SYLLABUS

UNIT-I INTEL8051 9

Introduction to Embedded System. Architecture, 8051- CPU Block diagram, Memory Organization, Program memory, Data Memory, Interrupts Peripherals: Timers, Serial Port, I/O Port Programming: Addressing Modes, Instruction Set, Programming Timing Analysis Case study with reference to 8-bit 8051 Microcontroller

UNIT II INTRODUCTION FOR 32 BIT ARM 920 9

32- Bit ARM920T Processor Core -Introduction: RISC/ARM Design Philosophy, About the ARM920T Core, Processor Functional Block Diagram. Programmers Model. Cache: Memory hierarchy and cache memory-. Memory Management Units: - ARM Instruction Set- Thumb Instruction Set-. Interrupt Handling

UNIT III ARM PROCESSOR ORGANIZATION 9

ARM9 Microcontroller Architecture-Block Diagram, Features, Memory Mapping Memory Controller (MC)-External Bus Interface (EBI)-External Memory Interface-Interrupt ControllerSystem Timer (ST- Real Time Clock (RTC) Parallel Input/output Controller (PIO)

UNIT IV PERIPHERALS OF ARM PROCESSOR 9

AT91RM9200 PERIPHERALS -Universal Synchronous Asynchronous Receiver Transceiver (USART)-Block Diagram, Functional Description, Synchronous and Asynchronous Modes

UNIT V DEVELOPMENT & DEBUGGING TOOLS FOR MICROCONTROLLER BASED EMBEDDED SYSTEMS 9

Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), LogicAnalyser.

TEXTBOOK :

1.Intel Hand Book on "Embedded Microcontrollers", 1st Edition
2.Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2e, PHI
3.ARM Company Ltd. "ARM Architecture Reference Manual– ARM DDI 0100E"

REFERENCES:

4.David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
5.Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier
6.Ayala, Kenneth J "8051 Microcontroller - Architecture, Programming & Applications", 1st Edition, Penram International Publishing L T P C 4 2 0 4 Page 13 of 42

COURSE OUTCOMES (COs)	
CO1	understand the system requirements specifications, architectural and detailed design of 8051
CO2	understand the system requirements specifications, architectural and detailed design of ARM920T
CO3	understand the system requirements specifications, architectural and detailed design of ARM9
CO4	Understand about the bus and memory interfaces used for ARM
CO5	Understand about the peripherals used for ARM
CO6	Understand the development and debugging tools used for microcontroller based embedded system

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

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	M	H	H	H	M			M	M	M	H
	CO2	M	H	H	H	H			M	M	M	H
	CO3	M	H	H	H	H			M	M	M	H
	CO4	M	H	H	H	M			M	M	M	M
	CO5	M	H	H	H	M			M	M	M	M
	CO6	M	H	H	H	H			M	M	M	H

Category		Professional Core
4	Approval	47th Meetings of Academic Council, Aug, 2018

P18PEAE013	**ADVANCED DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

SYLLABUS

UNIT 1 DIGITAL IMAGE FUNDAMENTALS 9

Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Basic Relationships between Pixels; Monochromatic Vision Models; Colour Vision Models; Colour Fundamentals; Colour Models; Conversion of Colour Models; Colour Transformations.

UNIT 2 ENHANCEMENT & RESTORATION 9

Introduction; Point Processing – Image Negatives, Log transformations, Power Law Transformations, Piecewise-Linear Transformation Functions; Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Histogram Processing – Histogram Equalization, Histogram Matching; Spatial filtering – Smoothing, Sharpening; Smoothing Frequency Domain Filters – Ideal Low Pass, Butterworth Low Pass, Gaussian Low Pass; Sharpening Frequency Domain Filters – Ideal High Pass, Butterworth High Pass, Gaussian High Pass; Model of Image Degradation/Restoration Process; Noise Models; Inverse Filtering; Geometric Transformations.

UNIT 3 IMAGE ANALYSIS 9

Introduction; Image Segmentation – Point, Line, Edge, Boundary Detection; Colour Image Segmentation; Thresholding – Basic Global Thresholding, Multiple Thresholding, Variable Thresholding; Region Based Segmentation; Feature Extraction – Amplitude Features, Histogram Features, Shape Features, Texture Features, Spectral Features.

UNIT 4 MORPHOLOGICAL PROCESSING & COMPRESSION 9

Morphological Image Processing – Logic Operations involving Binary Images; Dilation and Erosion; Opening and Closing; Basic Morphological Algorithms – Boundary Extraction, Region Filling, Thickening, Thinning; Image Compression – Compression Model, Huffman Coding, Arithmetic Coding.

UNIT 5 3D IMAGE PROCESSING & APPLICATIONS 9

Sources of 3D Data; 3D Data Sets; Slicing the Data set; Volumetric display; processing in 3D; Measurements on 3D images; Applications of Image Processing – Motion Image Classification.

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 2nd Edition, Pearson

Education, Inc., 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning Private Limited, New Delhi, 2002.
3. John C. Russ, The Image Processing Handbook, 6th Edition, CRC Press, Taylor & Francis Group, 2011.
4. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson Education, Inc., 2004.
5. William K. Pratt, Digital Image Processing, 3rd Edition, John Wiley & Sons, Inc., 2001.
6. Bernd Jähne, Digital Image Processing, 5th Revised and Extended Edition, Springer, 2002.
7. RafealC.Gonzalez, Richard E.Woods and Steven L. Eddins, Digital Image Processing using Matlab, Pearson Education, Inc.,

COURSE OUTCOMES (COs)	
CO1	Able to understand the digital image fundamentals
CO2	To gain knowledge in image Enhancement and Restoration
CO3	To Analyze the image segmentation and feature Extraction
CO4	To understand Morphological processing Algorithm
CO5	To Learn Image Compression model.
CO6	To gain knowledge in 3D Image processing

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	M	M	H	H	H					M	L
	CO2		M	M	H					M		
	CO3		M	H	H					M		
	CO4	M		M	H							H
	CO5	H	M	H	H							
	CO6	M	M	H	H					H	M	H
3	Category	Professional Electives										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE021	**ADVANCED COMPUTER ARCHITECTURE DESIGN**	**L**	**T**	**P**	**C**

	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Architecture				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To understand the difference between the pipeline and parallel concepts and To study the various type architectures and the importance of scalable architectures and To study the various memories optimization of memory.

SYLLABUS

UNIT-I THEORY OF PARALLESISM –PART-I 8

Parallel computer models-the state of computing, Multiprocessor and Multicomputer and Multivectors and SIMD computers, PRAM and VLSI mode Architectural development tracks .Program and properties Conditions of parallelism.

UNIT-II THEORY OF PARALLELISM –PART-II 8

Program partitioning and scheduling, Program flow mechanism, System inter connect architecture, Principles of scalable performance–performance matrices and measures, Parallel processing application speedup performance laws, scalability analysis and approaches.

UNIT-III HARDWARE TECHNOLOGIES 10

Processor and memory hierarchy advanced processor technology, superscalar and vector processors, memory hierarchy technology, virtual memory technology, bus cache and shared memory-backplane bus systems, cache memory organizations, shared memory organization, sequential and weal consistency model.

UNIT-IV PIPELINING AND SUPERSCALAR TECHNOLOGIES 10

Parallel and scalable architectures, Multiprocessor and Multicomputers, Multivectors and SSIMD Computers, Scalable Multithread and dataflow architectures.

UNIT-V SOFTWARE AND PARALLEL PROCESSING 9

Parallel models, Languages and compilers, Parallel program development and environments, UNIX, MACH and OSF/1 for parallel computers.

TEXT BOOK:

1.KaiHawang, “Advanced Computer Architecture”, McGraw Hill international, 1993.

REFERENCES BOOK:

1.William Stallings, “Computer Organization and Architecture”, Macmillan Publishing Company, 1990.

2. M.J.Quinn, “Designing Efficient Algorithms for Parallel Computer”, McGraw Hill

International1994.

COURSE OUTCOMES (COs) At the end of the course, the student will be able to:												
CO1	Know the classes of computers, and new trends and developments in computer architecture.											
CO2	Compare and evaluate the performance of various architectures.											
CO3	Design sub-systems to meet specific performance requirements											
CO4	Analyze the requirements of large systems to select and build the right infrastructure.											
CO5	To study the various memories and optimization of memory.											
CO6	To analyze Parallel program development and environments											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L 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	M	L	L	H	H			H	H	M	H
	CO2	M	L	L	M	M			M	L	L	M
	CO3	H	M	H	M	L			M	M	L	L
	CO4	M	M	M	L	L			H	M	M	M
	CO5	L	L	L	H	M			M	M	L	M
	CO6	H	H	M	M	M			H	H	M	L
3	Category	PE										
4	Approval	47th Meetings of Academic Council, Aug, 2018										
COURSE OUTCOMES (COs) At the end of the course, the student will be able to:												
CO1	Know the classes of computers, and new trends and developments in computer architecture.											
CO2	Compare and evaluate the performance of various architectures.											
CO3	Design sub-systems to meet specific performance requirements											
CO4	Analyze the requirements of large systems to select and build the right infrastructure.											
CO5	To study the various memories and optimization of memory.											
CO6	To analyze Parallel program development and environments											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low												

P18PEAE022	**MODELING AND SIMULATION OF COMMUNICATION NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Computer Networks				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- Learn modeling and simulation
- Understand Monte Carlo simulation
- Study channel modeling and mobility modeling

SYLLABUS

UNIT I -INTRODUCTION TO MODELING AND SIMULATION 9

Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.\

UNITII MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT III -LOWER LAYER & LINK LAYER WIRELESS MODELING 9

Physical Layer Modeling, Description of the Main Components of the PHY Layer, Accurate Simulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queueing and Processing Delay.

UNIT IV CHANNEL MODELING & MOBILITY MODELING 9

Channel Modeling :The Physics of Radiation, The Nature of Electromagnetic Radiation, Classification of Propagation Models, Deterministic Approaches by Classical Field Theory, Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, Stochastic Shadowing Models, Stochastic Fading Models, MIMO Channel Models. Mobility modeling :Categorization of Mobility Models, Mobility Models, Random Walk Model, Random Waypoint Model, Random Direction Model, Gauss-Markov Model, Manhattan Model, Column Model , Pursue Model, Nomadic Community Model, Selection of Appropriate Mobility Models

UNIT V HIGHER LAYER MODELING & MODELING THE NETWORK TOPOLOGY9

Higher Layer Modeling :Modeling the Network Layer and Routing Protocols, Components of a Routing Protocol, Metrics, Virtual Routing on Overlays, Modeling Transport Layer Protocols, Modeling Application Traffic. Modeling the Network Topology : Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Geometric Random Graphs – The Waxman Model, Hierarchical Topologies, Preferential Linking – The Barabási-

Albert Model , Modeling the Internet.

REFERENCES:

1. Irene Karzela, "Modeling and Simulating Communications Networks", Prentice Hall India, 1998.
2. K.Wehrie. Gunes, J.Gross, "Modeling and Tools for Network simulation", Springer, 2010.
3. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, "Simulation of Communication Systems: Modeling, Methodology and Techniques", Plenum Press, New York, 2001.
4. Nejat; Bragg, Arnold, "Recent Advances in Modeling and Simulation Tools for Communication Networks and Services", Springer, 2007
5. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation", Pearson Education (Singapore) Pvt. Ltd, 2004.

P18PEAE023	**ADVANCED DIGITAL CONTROL SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To impart knowledge on various types of controllers.
- To provide advanced understanding of adaptive principles.
- To understand the basic digital control systems and their relationship to continuous systems.
- To understand of controller design methods based on z-plane.

SYLLABUS

UNIT 1 PRINCIPLES OF CONTROLLERS9.

Review of frequency and time response analysis and specification of control system, need for controller, continuous time compensation, continuous time PI, PD, PID controllers, Digital PID Controllers - Sampling and holding – Sample and hold devices – D/A and A/D conversion – observability.

UNIT 2 DESIGN USING TRANSFORM AND STATE SPACE TECHNIQUES9

Reconstruction – Z transform – Inverse Z transform – Properties – Pulse transfer function and state variable approach – Review of controllability, Methods of discretisation – Comparison – Direct design – Frequency response methods – State space design – Pole assignment – Optimal control – State estimation in the presence of noise – Effect of delays.

UNIT 3 COMPUTER BASED CONTROL9

Selection of processors – Mechanization of control algorithms – PID control laws -Predictor merits and demerits – Application to temperature control – Control of electric drives – Data

communication for control.

UNIT 4 PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS 9

Algorithm development of PID control algorithms-Software implementation- Implementation using microprocessors and microcontrollers-Finite word length effects-, Choice of data acquisition systems- Microcontroller based temperature control systems-Microcontroller based motor speed control systems.

UNIT 5 QUANTIZATION EFFECTS AND SAMPLE RATE SELECTION9

Analysis of round off error – Parameter round off – Limit cycles and dither – Sampling theorem limit – Time response and smoothness – Sensitivity to parameter variations – Measurement noise and antialising filter – Multirate sampling.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Ogata.K (1987)- Discrete time control systems PHI.
2. Gopal.M., "Digital control Engineering ", Wiley Eastern Ltd.,1989.
3. Franklin G.F. David Powell.J Michael Workman, "Digital control of Dynamic Systems", 3rd Edition, Addison Wesley, 2000.
4. Paul Katz, "Digital control using Microprocessors", Prentice Hall International, 1982.
5. Forsytheand.W.Goodall. R.N., "Digital Control", McMillan,1 991.
6. Chesmond, Wilson, Lepla, "Advanced Control System Technology", Viva – low price edition, 1998.

COURSE OUTCOMES (COs)	
CO1	Design digital controllers in the z-domain and by approximation of s-domain design
CO2	Able to design using z-Transform and state space Techniques
CO3	To understand Computer based control
CO4	To gain knowledge about practical aspects of Digital control Algorithm
CO5	To understand data Acquisition system
CO6	To gain knowledge about Quantization effects and sample rate selection

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	M	M	L	M			M	L	M	M
	CO2	H	M	M	H	M			M	L	L	M
	CO3	M	H	M	H	M			M	L	M	L
	CO4	M	H	H	L	M			L	M	M	L
	CO5	H	M	M	L	M			M	L	M	L

	CO6	M	H	M	M	H			M	H	L	M
3	Category	Professional Electives										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE031	**MULTIDIMENSIONAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Digital signal processing				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To comprehend the concepts of digital image processing

To acquire knowledge about image preprocessing

To study the various 2D transforms and their applications to image processing

To study the various techniques involved in tomographic imaging and to understand the concept of 3D visualization

SYLLABUS

UNIT 1 DIGITAL IMAGE FUNDAMENTALS9

Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Basic Relationships between Pixels; Monochromatic Vision Models; Colour Vision Models; Colour Fundamentals; Colour Models; Conversion of Colour Models; Colour Transformations.

UNIT 2 IMAGE PREPROCESSING9

Introduction; Point Processing – Image Negatives, Log transformations, Power Law Transformations, Piecewise-Linear Transformation Functions; Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Histogram Processing – Histogram Equalization, Histogram Matching.

UNIT 3 2D TRANSFORMS 9

2D ORTHOGONAL, 2D UNITARY TRANSFORM,INTRODUCTION TO 2D Discrete Fourier Transform , Discrete Cosine Transform, Discrete Sine Transform, Welsh- Hadamard Transform, Haar Transform, Slant Transform, Singular Value Decomposition, ,Karhunen-Loeve Transforms.

UNIT 4 TOMOGRAPHIC IMAGING 9

More than two dimensions, Volume imaging vs. sections, Basics of reconstruction, Algebraic reconstruction methods, Maximum entropy , Defects in reconstructed images, Beam hardening, Imaging geometries, Three-dimensional tomography, High-resolution tomography.

UNIT 5 3D VISUALIZATION 9

Sources of 3D data,Serialsections,Optical sectioning, Sequential removal, Stereo measurement, 3D data sets, Slicing the data set, Arbitrary section planes, Volumetric display ,Stereo viewing ,Special display hardware, Ray tracing Reflection , Surfaces, Multiply connected surfaces, Image

processing in 3D, Measurements on 3D images.
Max. 60 Hours

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 2nd Edition, Pearson Education, Inc., 2004.
2. John C. Russ,The IMAGE PROCESSING, Handbook, Sixth Edition,CRC Press.
3. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning Private Limited, New Delhi, 2002.
4. William K. Pratt, Digital Image Processing, 3rd Edition, John Wiley & Sons, Inc., 2001.
5. RafealC.Gonzalez, Richard E.Woods and Steven L. Eddins Digital Image Processing using Matlab, Pearson Education, Inc., 2004.
6. Bernd Jähne, Digital Image Processing, 5th Revised and Extended Edition, Springer, 2002.

COURSE OUTCOMES (COs)	
CO1	.To understand digital Image fundamentals
CO2	To gain knowledge in Image preprocessing
CO3	To Learn various 2D transforms and applications
CO4	.To gain knowledge in various techniques in Tomogrphic imaging
CO5	To Learn the concepts of 3D Tomography
CO6	To understand the concept of 3D visualization
	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	l
2	CO1	M	M	H	M					M	H		L
	CO2	M	H		H					M		M	
	CO3	H	M	M									L
	CO4											M	
	CO5	H		L	M					M	M		
	CO6												
3	Category		Engg Sciences (ES)										
4	Approval		47th Meetings of Academic Council, Aug, 2018										

P18PEAE032	**ADVANCED CRYPTOGRAPHY AND DATA SECURITY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Cryptography and Network Security				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To study various aspects of Network Security Attacks, Services and Mechanisms.

SYLLABUS

UNIT I -INTRODUCTION **9**

Security Services, Mechanisms and Attacks – Network Security Model-Classical Encryption Techniques – Steganography – Data Encryption Standard (DES)

UNITII ADVANCED BLOCK CIPHERS AND PUBLIC KEY CRYPTOSYSTEMS9

Block cipher modes operation – Overview of IDEA, Blowfish, RC5, CAST-128 – Characteristics of advanced symmetric Block ciphers – Key Distribution – Principle – RSA algorithm – Public Key Management – DiffieHellmen Key Exchange – X.509 Public Key Certificate Format.

UNIT III -MESSAGE AUTHENTICATION AND DIGITAL SIGNATURE **9**

Message Authentication codes – MAC – HASH function – Principle of MD5, SHA-1 and HMAC algorithms-Digital Signature algorithm.

UNIT IV NETWORK SECURITY **9**

Authentication Application – Kerbros – Email Security – PGP – Network Security – IPSec – Web Security – SSL – SET.

UNIT V INTRUSION DETECTION SYSTEM **9**

Intrusion Detection – Password management – Malicious software – Viruses and countermeasures – Firewall Types and Configurations – Trusted System.

TEXTBOOKS:

1. William Stallings, "Cryptography and Network Security", Pearson Education, 5th Edition, New Delhi, 2011

.

2. Forouzan.B.A. andMukhopadhyay.D, "Cryptography and Network Security", Tata Mc-Graw Hill, 2nd Edition, 2010.

REFERENCES:

1. William Stallings, "Cryptography and Network Security", PHI, New Delhi, 2nd Edition, 1999.

COURSE OUTCOMES (COs)	
CO1	To understand the mathematical concepts of various Encryption, Authentication and Digital Signature Algorithms.
CO2	To standby the design of different general purpose and application specific security Protocols and standards.
CO3	To understand the concepts of Message Authentication
CO4	To study about various digital signature algorithm

CO5	To gain knowledge about various types of Network security
CO6	To gain knowledge about various types of system security

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	H	M	M	M	M			M	L	M	M
	CO2	H	L	L	M	M			L	M	L	M
	CO3	M	L	L	M	M			L	L	M	L
	CO4	H	M	M	L	M			M	L	L	M
	CO5	M	M	H	H	M			H	M	M	L
	CO6	H	M	M	M	L			M	L	M	L
3	Category	Professional Electives										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE033	**INTELLIGENT COMPUTING TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Introduction to Computing and MATH Calculus II				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- Introduction to mathematical modeling and the numerical solution of engineering problems.
- Numerical errors: Computer representation of real numbers. Accuracy, precision, and round-off error.

SYLLABUS

UNIT I - INTRODUCTION TO COMPUTATIONAL INTELLIGENCE 9

Computational intelligence paradigms: Artificial Neural networks, evolutionary Computation, swam intelligence, artificial immune systems and fuzzy systems. Introduction to Evolutionary computation: Genetic evolutionary algorithms, Representation, Initial population, fitness function, selection, reproduction of operators, stopping conditions and evolutionary computation

versus classical optimization

UNIT II - GENETIC ALGORITHMS AND PROGRAMMING9

Genetic algorithms: Canonical GA, crossover, mutation, control parameters, GA variants, applications Genetic programming: Tree based representation, initial population, fitness function, cross over operators, mutation operators, building block in Genetic programming.

UNIT III - EVOLUTIONARY PROGRAMMING AND ITS STRATEGIES 9

Basic of Evolutionary programming- operators- strategy parameters- implementations- Genetic evolutionary strategy algorithms-strategy parameters and self adoption- evolution strategy variants.

UNIT IV - DIFFERENTIAL EVOLUTION9

Basic differential evolution-Variations to basic DE- DE for discrete valued problems. Convolution: Convolution types- competitive Convolution – co-operative Convolution

UNIT V - COMPUTATIONAL SWAM INTELLIGENCE9

Particle swarm optimization: Basics- social network structures- Basic variations- PSO parameters- single solution PSO- applications Ant algorithms: ant colony optimization Meta-Heuristic- Cemetery organization and brood care- division of labor-Applications

REFERENCES

1. Andries P Engel Brecht, “Computational intelligence an introduction”, Wiley publications, 2nd Edition, 2007.
2. Goldberg,” Genetic algorithms in search, optimization and machine learning” Pearson Education India, 2007 Edition.

COURSE OUTCOMES (COs)	
CO1	To understand the concept of computational intelligence
CO2	To explore genetic and evolutionary algorithms
CO3	To learn the knowhow of differential evolution
CO4	To understand the concept of Particle swarm optimization and ant colony algorithms
CO5	To learn differential equations
CO6	To analyze its applications

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	H	M	M	H			L	M	L	M
	CO2	H	M	M	H	M			L	M	L	L
	CO3	M	M	H	M	L				L	M	

	CO4	M	L	M	M	L				L		M
	CO5	H	M	M	M	M			M	L	M	L
	CO6	M	M	L	M	L			M	L		L
3	Category	Professional Electives										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE041	**DSP INTEGRATED SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Signal Processing				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

- To familiarize the concept of DSP and DSP algorithms.
- Introduction to Multirate systems and finite wordlength effects
- To know about the basic DSP processor architectures and the synthesis of the processing elements

SYLLABUS

UNIT I INTRODUCTION TO DSP INTEGRATED CIRCUITS 9

Introduction to Digital signal processing, Sampling of analog signals, Selection of sample frequency,Signal- processing systems, Frequency response, Transfer functions, Signal flow graphs, Filterstructures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT Algorithm, Imagecoding, Discrete cosine transforms, Standard digital signal processors, Application specific ICs forDSP, DSP systems, DSP system design, Integrated circuit design.

UNIT IIDIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS 9

FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analogtransfer functions, Mapping of analog filter structures, Multi rate systems, Interpolation with an integerfactor L, Sampling rate change with a ratio L/M, Multi rate filters. Finite word length effects – Parasiticoscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficientsensitivity, Sensitivity and noise.

UNIT III DSP ARCHITECTURES 9

DSP system architectures, Standard DSP architecture-Harvard and Modified Harvard architecture.Ideal DSP architectures, Multiprocessors and multi computers, Systolic and Wave front arrays,Shared memory architectures.

UNIT IV SYNTHESIS OF DSP ARCHITECTURES 9

Synthesis: Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs. Combinational & sequential networks-Storageelements – clocking of synchronous systems, Asynchronous systems -FSM

UNIT V ARITHMETIC UNIT AND PROCESSING ELEMENTS 9

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel andBit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing thememory size, Complex multipliers, Improved shift-accumulator. Case Study: DCT and FFT processor.

REFERENCES:

1. B.Venkatramani, M.Bhaskar, "Digital Signal Processors", Tata McGraw-Hill, 2002
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002
3. KeshabParhi, "VLSI Digital Signal Processing Systems design & Implementation", John Wiley & Sons, 1999.
4. Lars Wanhammer, "DSP Integrated Circuits", Academic press, New York, 1999.

COURSE OUTCOMES (COs)	
CO1	To know about the Digital Signal Processing concepts and its algorithms
CO2	To learn about finite word length effects in digital filters
CO3	To learn the Concept behind multi rate systems
CO4	To familiarize with the DSP processor architectures to perform synthesis of processing elements
CO5	To understand the baic concepts of oscillators its types and their simulation
CO6	To analyze the noise characteristics in analog 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	H	M			M	M	H	H
	CO2	H	H	M	M	H			M	H	M	H
	CO3	H	H	M	M						M	M
	CO4	H	H	H	H	M			M	H	M	H
	CO5	H	H	H	M	M			M	M		M
	CO6	M	M						M			
	Category	Professional Elective										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE042	**LOW POWER VLSI DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – VLSI Design				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

- To know the sources of power consumption in CMOS circuits and to understand the various power reduction techniques and the power estimation methods.

SYLLABUS

UNIT I POWER DISSIPATION IN CMOS 9Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOSFET devices – Basic principle of low power design.

UNIT II POWER OPTIMIZATION 9

Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power system – reducing power consumption in memories –low power clock, Inter connect and layout design – Advanced techniques –Special techniques.

UNIT IV POWER ESTIMATION 9

Power Estimation techniques – logic power estimation – Simulation power analysis – Probabilistic power analysis.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power – Behavioral level transform – software design for low power.

TEXT BOOKS:

1. Gary Yeap "Practical Low Power Digital VLSI Design", 1997.
2. Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", Wiley, 2000.

REFERENCES:

1 DimitriosSoudris, ChirstianPignet, Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2002.
2. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999.
3..A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995.
4. AbdelatifBelaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995.
5. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", John Wiley and sons, inc. 2001.

COURSE OUTCOMES (COs)	
CO1	Identify sources of power in an IC
CO2	Identify the power reduction techniques based on technology independent and technol dependent
CO3	Power dissipation mechanism in various MOS logic style.

CO4	Identify suitable techniques to reduce the power dissipation.
CO5	To learn about power estimation techniques
CO6	Design memory circuits with low power dissipation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
		Professional Elective										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE043	**REAL TIME OPERATING SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

- The aim of the course is to impart the concepts related to operating systems concepts and to discuss about RTOS application domains.
- To study about client server model- distributed file systems.
- To learn about synchronization control blocks
- To know about comparison and study of various RTOS like QNX-VX works
- To understand RTOS for image processing

SYLLABUS

UNIT – I REVIEW OF OPERATING SYSTEMS 9

Basic Principles – System calls – Files – Processes – Design and Implementation of Processes – Communication between Processes – Operating System Structures.

UNIT – II DISTRIBUTED OPERATING SYTEMS 9

Topology – Network types – communication – RPC- client server model- distributed file systems- design strategies.

UNIT – III REAL TIME MODELS AND LANGUAGES 9

Events based – process based and graph based models – petrinet models – real time languages –

RTOS tasks – RT scheduling – interrupt processing – synchronization control blocks – memory requirements.

UNIT – IV REAL TIME KERNEL9

Principles – design issues – Polled loop systems - RTOS porting to a target – comparison and study of various RTOS like QNX-VX works – PSOS – C executive - Case studies.

UNIT – V RTOS APPLICATION DOMAINS9

RTOS for image processing - Embedded RTOS for voice over IP – RTOS for voice over IP – RTOS for fault tolerant applications – RTOS for control systems.

TEXT BOOKS:

1. Herma K, " Real time systems – Design for distributed Embedded Applications ",Kluwer Academic, 1997.
2. Charles Crowly, "Operating System – A design oriented approach" McGraw Hill, 1997.

REFERENCES:

1.R.J.ABhur, D.L. Bailey, "An introduction to Real Time Systems', PHI 1999.

2.C.M. Krishna, Kang G Shin, "Real time systems", McGraw Hill, 1997.

COURSE OUTCOMES (COs)	
CO1	understand and review about different operating system.
CO2	understand about networking and distributed operating system
CO3	understand about real time models and languages
CO4	understand about real time kernel
CO5	know about various application domains in RTOS
CO6	Understand about RTOS control system

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

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	M		H	M				M	M	H	H
	CO2	M		H	M				M	M	H	H
	CO3	M		H	M				M	M	H	H
	CO4	M		H	M				M	M	H	H
	CO5	M		H	M				M	M	H	H
	CO6	M		H	M				M	M	H	H

Category		Professional Elective
4	Approval	xxxxxth Meeting of Academic Council, May 2018

P18PEAE051	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Microwave Engineering				
	Course Designed by: – Department of Electronics & Communication Engineering				

Course Objectives:

- To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
- To understand EMI sources and its measurements.
- To understand the various techniques for electromagnetic compatibility

SYLLABUS

UNIT I EMI ENVIRNONMENT **6**

Sources of EMI, Conducted and radiated EMI, Transient EMI, EMI – EMC Definition and units of Parameters.

UNIT II EMI COUPLING, PRINCIPLES **9**

Conducted, Radiated and Transient coupling, Common impedance ground coupling radiation common mode and ground loop coupling, radiated differential mode coupling near Field, cable to cable Coupling, power mains and power supply coupling.

UNIT III EMI SPECIFICATIONS / STANDARDS / LIMITS **7**

Units of specifications civilian standard, military standards.

UNIT IV EMI MEASUREMENTS **7**

EMI test instruments / systems, EMI test / EMI shielded chamber, open area test site, TEM cell antennas, conductors sensors / injectors / couplers, military test method and procedures, calibration procedures.

UNIT V EMI CONTROL TECHNIQUES **7**

Shielding, filtering, grounding, bonding, isolation transformation, transient suppressor, cable routing, signal control, component selection and mounting.

EMC DESIGN OF PCB'S **9**

PCB traces crosstalk, impedance control, power distribution decoupling, zoning, mother board design and propagation delay models.

TEXTBOOKS:

1. Bernard Keiser, "Principles of EMC" ,Artech House, 3rd, 1986.
2. Henry W. Ott "Noise Techniques in electronics systems" Willey and sons, New York, 1998.
3. B.P Kodali, "Engineering EMC Principles, Measurements and technologies", IEEE Press, 1996.

REFERENCE BOOK:

1. Christos christopoulos ,Principles and Techniques of Electromagnetic Compatibility, CRC Press, 2 edition (21 June 2007).

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Real-world EMC design constraints and make appropriate tradeoffs to achieve the most cost-effective design that meets all requirements
CO2	Designing electronic systems that function without errors or problems related to electromagnetic compatibility
CO3	Diagnose and solve basic electromagnetic compatibility problems
CO4	To be able to apply Maxwell's equations for electromagnetic systems.
CO5	To able to design systems to mitigate the effects of Electromagnetic Interference.
CO6	To design systems with Electromagnetic compatibility

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			M	H	H	M
	CO2	M	H	M	H	M			M	M	H	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	M	H	M	H			H	H	M	H
	CO6	H	M	M	H	H			M	M		H
3	Category	PE										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

P18PEAE052	**ADVANCED ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital signal processing				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

x To understand robot programming languages.
x To introduce robot arm kinematics
x To understand the concept of material transfer & machine loading / unloading
x To educate robotic assembly automation and inspection automation.

SYLLABUS

UNIT 1 INTRODUCTION9

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 2 ROBOT ARM KINEMATICS 9

Direct and Inverse Kinematics - rotation matrices - composite rotation matrices - Euler angle representation - homogeneous transformation – DenavitHattenberg representation and various arm configurations.

UNIT 3 ROBOT ARM DYNAMICS9

Lagrange - Euler formulation, joint velocities - kinetic energy - potential energy and motion equations – generalized D'Alembert equations of motion.

UNIT 4 ROBOT APPLICATONS9

Material Transfer & Machine Loading / Unloading General Consideration in robot material handling transfer applications – Machine loading and unloading. Processing Operations Spot welding – Continuous arc welding - spray coating – other processing operations using robots.

UNIT 5 ASSEMBLY AND INSPECTION 9

Assembly and robotic assembly automation – Parts presentation methods – assembly operation – Compliance and the Remote Center Compliance(RCC) device – Assembly system Configurations – Adaptable, Programmable assembly system – Designing for robotic assembly – Inspection automation.

TEXT / REFERENCE BOOKS

1. Fu,Gonazlez K.S, and Lee, C.S.G. "Robotics" (Control, Sensing, Vision and Intelligence),McGraw Hill, 1968(II printing).
2. Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition, 1988.
3. Asada and Slotine, "Robot analysis and Control", John Wiley and sons, 1986.
4. Philippe Coiffet, "Robot technology" Vol.II (Modelling and control), Prentice Hall INC., 1983.
5. GrooverM.P.Mitchell Weiss "Industrial Robotics Technology Programming and Applications", Tata McGraw Hill, 1986.

COURSE OUTCOMES (COs)	
CO1	To understand the Introduction of Robots
CO2	To Learn the concepts of Robot ARM Kinematics
CO3	To understand the concepts Robot ARM Dynamics
CO4	To gain knowledge in ROBOT Applications
CO5	Able to demonstrate robotic assembly automation

CO6	Able to demonstrate inspection automation.

	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	L
2	CO1	L	M	M		H							
	CO2	M	L	L		M				M			
	CO3				H						L		
	CO4	M		H		L						M	
	CO5	M	H		M					M		M	
	CO6	M	H			M							
3	Category		PE										
4	Approval		47th Meetings of Academic Council, Aug, 2018										

P18PEAE053	**ADVANCED WIRELESS COMMUNICATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Communication				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

To enable the student to understand the evolving paradigm of cooperative and green wireless communication concepts and the challenges and trade-offs involved in such networks.

SYLLABUS

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations ; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS **9**

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment , Cooperative multicell processing techniques for energy-efficient cellular wireless communications.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS **9**

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TEXT BOOKS:

1. EkramHossain, Dong In Kim, Vijay K. Bhargava , "Cooperative Cellular Wireless Networks", Cambridge University Press, 2011.
2. EkramHossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.
3. F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012.

REFERENCES:

1. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access", GRINVerlag, 2012.
2. Mohammad S. Obaidat, AlaganAnpalagan and Isaac Woungang, "Handbook of Green Information and Communication Systems", Academic Press, 2012.
3. Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers, 2010.
4.Jinsong Wu, SundeepRangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.

COURSE OUTCOMES (COs)	
CO1	The student would be able to appreciate the necessity and the design aspects of cooperative and green wireless communication.
CO2	The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
CO3	The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.
CO4	The student able to understand the different power saving strategies and energy efficient signal, system and network design.
CO5	The student expose the energy saving techniques adopted in existing wireless components, protocols and networks.
CO6	The Students will have the knowledge about the evolution of green future wireless communication technologies.
Mapping of Course Outcomes with Student Outcomes (SOs)	
(S/M/L 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	H			H	H						
	CO2	H	H		H					M		M
	CO3	H	H		H	H				M		M
	CO4		M		H		M					
	CO5	M			M					H		
	CO6		H		H		L			H		M
3	Category	PE										
4	Approval	47th Meetings of Academic Council, Aug, 2018										

OPEN ELECTIVES

P18OEAE001	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineeri				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Module 1 **9 Hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 **9 Hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 **9 Hours**

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module 4 **9 Hours**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module 5 **5 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module 6 **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

Module 1 **9 Hours**

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.

Module 2 **9 Hours**

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.

Module 3 **9 Hours**

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

Module 4 **9 Hours**

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.

Module 5 **9 Hours**

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

Total No. of Periods: 45

References Books:

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.

P18OEME003	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

Module 1 **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module 2 **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3 **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 4 **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5 **9 Hours**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module 1: 9 Hours

Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module 2: 10 Hours

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module 3:10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 4: **6 Hours**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineeri				

Module 1 **9 Hours**

Introduction

Definition – Classification and characteristics of Composite materials.Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2 **9 Hours**

Reinforcements

Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module 3 **9 Hours**

Manufacturing of Metal Matrix Composites

Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module 4 **9 Hours**

Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method –

Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module 5 **9 Hours**

Strength

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE005	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

Module 1 **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2 **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3 **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –

Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4 **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5 **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 & AUDIT 2

	AUDIT : ENGLISH FOR RESEARCH PAPER WRITING	**L**	**T**	**P**	**C**
P18ACEN001	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title

SYLLABUS:

UNIT I: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness.

UNIT II: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

UNIT III: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT IV: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches,

planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I: **4 Hours**

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II: **4 Hours**

Repercussions Of Disasters And Hazards: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: **4 Hours**

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV: **4 Hours**

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **4 Hours**

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI: **4 Hours**

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNIC KNOWLEDGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
Learning of Sanskrit to improve brain functioning.
Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III: **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-BhartiPublication,New Delhi

2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

Understanding basic Sanskrit language

Ancient Sanskrit literature about science & technology can be understood.

Being a logical language will help to develop logic in students

P18ACBA004	**AUDIT : VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to

Understand value of education and self- development.
Imbibe good values in students.
Let the should know about the importance of character.

SYLLABUS:

UNIT I: **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.judgements

UNIT II: **6 Hours**

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, CleanlinessHonesty, Humanity.Power of faith, National Unity.Patriotism. Love for nature, Discipline.

UNIT III: **6 Hours**

Personality and Behavior Development - Soul and Scientificattitude.Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.HappinessVs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

UNIT IV: **6 Hours**

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality ,Non violence ,Humility, Role of Women.All religions and same message.Mind your Mind ,Self-control.Honesty, Studying effectively.

Suggested reading

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	**AUDIT: CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS:

UNIT I: 4 Hours

History of Making of the Indian Constitution: HistoryDrafting Committee, (Composition & Working)

UNIT II: 4 Hours

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III: 4 Hours

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

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of MinistersJudiciary, 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, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

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.

Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	**AUDIT : PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I: **4 Hours**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and

Searching.

UNIT II: **2 Hours**

Thematic overview:Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

UNIT III: **4 Hours**

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: **4 Hours**

Professional development:: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V: **2 Hours**

Research gaps and future directions: Researchdesign,Contexts,Pedagogy Teacher education**,**Curriculum and assessment,Dissemination and research impact.

Suggested Reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
- ✓ Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- ✓ Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- ✓ Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
- ✓ Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- ✓ www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- ✓ What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

  What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

  How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT: STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To achieve overall health of body and mind

To overcome stress

SYLLABUS:

UNIT I: **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II: **8 Hours**

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

Develop healthy mind in a healthy body thus improving social health also

Improve efficiency

P18ACBA008	**AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To learn to achieve the highest goal happily

To become a person with stable mind, pleasing personality and determination

To awaken wisdom in students

SYLLABUS:

UNIT I: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

UNIT II:

Approach to day to day work and duties.**8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

UNIT III: **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested Reading

"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students

CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

M.Tech – Digital Communication and Networking
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCDC101	PC	Broadband Access Technologies	3	3	0	0	3
2	P18PCDC102	PC	Modern Digital communication Systems	3	3	0	0	3
3		PE	Professional Elective – 1	3	3	0	0	3
4		PE	Professional Elective – 2	3	3	0	0	3
5	P18PRDC103	PC	Research Methodology and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
7	P18PCDC1L1	PC	Communication Lab	4	0	0	4	2
8	P18PCDC1L2	PC	Signal processing lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCDC201	PC	Advanced RF system design	3	3	0	0	3
2	P18PCDC202	PC	Advanced Wireless Communication	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		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCDC2L1	PC	Networking Lab	4	0	0	4	2
7	P18PCDC2L2	PC	RF system design Laboratory	4	0	0	4	2
8	P18PRDC2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRDC3P2	PR	Phase – I Dissertation	20	0	0	20	10
			Total	26	6	0	20	16

SEMESTER IV

Sl.NO.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PRDC4P3	PR	Phase-II Dissertation	32	0	0	32	16
			Total	32	0	0	32	16

TOTAL CREDIT

18+18+16+16= 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEMA011	PE	Advanced Mathematics for Electronics Engineers	3	3	0	0	3
2	P18PEDC012	PE	VANET	3	3	0	0	3
3	P18PEDC013	PE	Microwave Integrated Circuits	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEDC021	PE	ASIC Design	3	3	0	0	3
2	P18PEDC022	PE	Non linear Signal Processing	3	3	0	0	3
3	P18PEDC023	PE	Wireless security and cellular mobile communication	3	3	0	0	3

PROFESSIONAL ELECTIVE – 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEDC031	PE	Image processing & pattern recognition	3	3	0	0	3
2	P18PEDC032	PE	Optical Communication Systems & Networks	3	3	0	0	3
3	P18PEDC033	PE	Global Tracking and Positioning System	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEDC041	PE	Modeling and simulation of communication networks	3	3	0	0	3
2	P18PEDC042	PE	Hardware and software Co-design	3	3	0	0	3
3	P18PEDC043	PE	Advanced Cryptography and Network security	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEDC051	PE	Electromagnetic Interference and Compatibility in System Design	3	3	0	0	3
2	P18PEDC052	PE	Distributed Processing and Networking	3	3	0	0	3
3	P18PEDC053	PE	Advanced Radiation Systems	3	3	0	0	3

OPEN ELECTIVE

S.No	**Code No.**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3

8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

Audit I& Audit II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18ACEN001	AC	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	AC	Disaster Management	2	2	0	0	0
3	P18ACEN003	AC	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	AC	Value Education	2	2	0	0	0
5	P18ACLW005	AC	Constitution of India	2	2	0	0	0
6	P18ACBA006	AC	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	AC	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	AC	Personality Development through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

P18PCDC101	**BROADBAND ACCESS TECHNOLOGIES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

This course is intended to gain complete knowledge about Basics of ISDN and BISDN together with key networking technologies of frame relay. To gain the knowledge about the concept of ATM Switching and transmission. To understand the concept SONET and its operations. To understand the Design of broadband networks. To have knowledge on broad band technologies.

SYLLABUS

UNIT I INTRODUCTION AND OVERVIEW 9

X.25, Frame relay, Integration of Transmission and Switching, Analog and Digital switching, Principles of ISDN, Architecture, ISDN standards, ISDN interface and 154 ITCE-Engg&Tech-SRM-2013 Functions, ISDN protocol architecture, ISDN connections, Addressing, Interworking.

UNIT II B-ISDN SERVICES AND PROTOCOL 9

B-ISDN protocols -User plane, management plane, control plane, signaling plane, Other aspects of B-ISDN: Broadcast service aspects, Network aspects and user network interface aspects, SONET-An overview.

UNIT III ATM TRANSMISSION AND SWITCHING 9

Overview, Virtual channels, Virtual paths, VP & VC switching, ATM cells, Header format, Generic flow control, Header error control, Transmission of ATM cells, Adaptation layer, AAL services and protocols. ATM switching building blocks, Input, Output buffering, Central buffering, Performance aspects of buffering switching networks.

UNIT IV BROAD BAND NETWORK DESIGN 9

Broad band Access network: Design-Requirements, and topology, Backbone network: design-requirement and topologies.

UNIT V WIRELESS BROADBAND 9

Introduction to Broadband Wireless, Evolution of Broadband Wireless; Fixed & Mobile Broadband Wireless; WiMAX and Other Broadband Wireless Technologies: overview.

TEXT BOOKS:

1.William Stallings, “ISDN and Broadband ISDN with Frame and ATM”, Pearson 4th edition, 2009

2.Robert C Newman “Broadband Communications”, Prentice Hall, 2002, ISBN 0-13-089321-8.

REFERENCES BOOKS:

1. Jeffrey G. Andrews, ArunabhaGhosh&RiasMuhamed, "Fundamentals of WiMAX: Understanding Broadband Wireless Networking", Prentice Hall, 2007.
2. John R Vacca, "Wireless Broadband Networks Handbook", Tata McGrawHill, 2001.

COURSE OUTCOMES (COs)	
CO1	Discuss and analyze the latest technologies in broadband communications including wireless components
CO2	Analyze different techniques and technologies required for the development of broadband communications.
CO3	Discuss the recent development of fiber-optic communication
CO4	Identify and evaluate challenges and opportunities concerning the applications of the latest broadband communications technologies.
CO5	Discuss about the next generation Internet protocols in current and emerging broadband communications.
CO6	Understand the knowledge of ISDN and BISDN applications.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	M					M		L
	CO3			M	H							
	CO4	M			H		H			M		H
	CO5		M	H	H		M			M		
	CO6	M	M	H	M		H			H	M	H
3	Category	PC										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCDC102	**MODERN DIGITAL COMMUNICATION SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To manipulate across various number system.
- To compute binary arithmetic operations.
- To design combinational and sequential circuits using gates.
- To give exposure to digital logic families and PLDs.

SYLLABUS

UNIT I INTRODUCTION 9

Elements of a digital communication system. An overview of source coding techniques for analog sources : temporal waveform coding. Spectral waveform coding model based source coding. Channel capacity &coding : channel models and channel capacity achieving channel with orthogonal signals.

UNIT II LINEAR BLOCKS CODES 9

The generator matrix & the parity cheek matrix. Example of linear block codes Cyclic codes. Hard decision and soft decision decoding of block codes. Performance Comparision of the above two schemes. Convolutional Codes: Transfer function of a conventional code. Optimum decoding of convolutional codes the viterbiAlgorithm , Probability of error for soft decision and hard decision decoding schemes. Practical considerations on the application of convolutional codes : coded modulation for bandwidth – constrained codes : coded modulation for bandwidth – constrained channels.

UNIT III BASE BAND TRANSMISSION 9

Characterisation of band limited channels. Signal design for band limited channels. Nyquist criterion for zero ISI.Partial response signaling, design of band limited signals with controlled ISI, data detection for controlled ISI. Signal design for channels with distortion. Optimum receivers for channel with ISI and AWGN.Equalisation : Linear , Decision feedback equalization. Adaptive linear equalizer, Adaptive decision feedback.

UNIT IV DIGITAL MODES 9

Principles of modern techniques.Power efficient modems. Review of ASK, FSK, PSK, QPSK, MSK and OMSK schemes. Constant envelope and non constant envelope modulation schemes.Power efficient modulation techniques and their receiver structure.Probability of error for binary modulation schemes.

UNIT V SPREAD SPECTRUM COMMUNICATION 9

Model of spread spectrum digital communication system. Direct sequence spectrum signals – some application. Effect of pulse interference on DS spread spectrum systems. Generation of PN sequence. Frequency hopped spread spectrum signals. CDMA system based on F + 1 spread spectrum signals. Other types of spread spectrum signals.Synchronisation of spread spectrum signals.

Total periods: 45

TEXT BOOKS:

1. J. G. PROAKIS: Digital communication 4th Edition. Mcgraw Hill, 2001.
2. K. FEHER. Wireless Digital Communication, P. H.New Delhi, 1995.

REFERENCE BOOK:

1. Modern Digital and Analog Communication Systems, B.P. Lathi (Author), Zhi Ding (Author), 4th Edition, Oxford Publications, 2009.
2. Communication systems ,Haykin, Simon S, Wiley, 2001
3. http://www.loc.gov/catdir/enhancements/fy0605.

COURSE OUTCOMES (COs)	
CO1	Students can recall the different number systems.
CO2	Demonstrate the simplification of Boolean expressions using Boolean algebra & K-Mapmethod.
CO3	Analyze the Combinational building blocks & Memory elements
CO4	Develop a state diagram and simplify the given sequential logic.
CO5	Summarize the different programmable logic devices & digital logic families.
CO6	Students can understand the effect of pulse interference on DS spread spectrum systems

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	H	H	H			H	H	H	H
	CO2	H	H	M	M	H						
	CO3	M	H	H	H	H			H	H	M	H
	CO4	H	H	M	H	H			H	H	H	H
	CO5	H	H	H	H	H			H	M	H	H
	CO6	H	M	H	H					M	M	L
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PRDC103	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	2	0	0	2
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

Student will understand research problem formulation and Analyze research related information

SYLLABUS

Unit I:LITERATURE SURVEY
Meaning of research problem, Sources of research problem, CriteriaCharacteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II: DATA ANALYSIS AND INTERPRETATION
Effective literature studies approaches, analysisPlagiarism, Research ethics,

Unit III: REPORT WRITING
Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit IV: NATURE OF INTELLECTUAL PROPERTY
Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit V: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR
Scope of Patent Rights.Licensing and transfer oftechnology.Patent information and databases.Geographical Indications, Administration of Patent System.Newdevelopments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

TEXT & REFERENCE BOOKS

1.Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To understand the Approaches of investigation of solutions for research problem
CO2	Students to analysis Plagiarism
CO3	To able to understand the Effective technical writing
CO4	Nature of Intellectual Property
CO5	Understand the concept of Patent Rights
CO6	To gain knowledge in New Developments in IPR

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H		H						H
	CO2	M	H	H		H						L

	CO3	M				M			H			L
	CO4	M	H	L		H			M			H
	CO5	M		M		M			L			
	CO6	M				L			H	M		
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCDC1L1	**COMMUNICATION LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**0**	**0**	**4**	**2**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To demonstrate digital communication concepts using hands-on experience and using simulation environments such as PSPICE /Multisim, or Matlab/Simulink, or LabVIEW.
- To use commercial, modular systems which have some distinct advantages over bread boarding to examine more complex communication topics and to deliver a hands-on laboratory experience.

LIST OF EXPERIMENTS:

1.FSK Modulation and Demodulation.

2. PSK Modulation and Demodulation.

3. QPSK Modulation and Demodulation.

4. DPSK Modulation and Demodulation.

5. PAM Modulation and Demodulation.

6. PWM Modulation and Demodulation.

7. PPM Modulation and Demodulation.

8. Pulse Code Modulation and Demodulation.

9. Delta Modulation and Demodulation.

10. Differential Pulse Code Modulation and Demodulation.

11. Data formatting.

12. BER comparison of different modulation schemes in AWGN channel in MATLAB ,

Simulink..

COURSE OUTCOMES (COs)	
CO1	To understand linear time invariant system with random inputs, and optimum receiver for AWGN channel.
CO2	To understand the Discrete channel models and its properties
CO3	To understand the Continuous channel models and its properties
CO4	Execute hardware implementation
CO5	They will have knowledge of basic types of digital modulation (ASK, FSK, and PSK) from mathematical description
CO6	Develop understanding about performance of digital communication systems

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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							L	M		L
	CO2	M	L	H								
	CO3	M			H						L	
	CO4	M				H				H		H
	CO5		L						M			
	CO6										H	
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCDC1L2	**SIGNAL PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To simulate and analyze various image processing and compression algorithms.

LIST OF EXPERIMENTS

1. Simulation of Low Pass Filtering

2. Simulation of Interference Suppression

3. Simulation of Edge detection using Sobel operator

4. Simulation of Point detection

5. Simulation of Line detection

6. Simulation of Linear and Circular convolution

7. Simulation of Discrete Fourier Transform

8. Simulation of Discrete Cosine Transform

9. Simulation of Image compression using JPEG standard

COURSE OUTCOMES (COs)	
CO1	At the end of the course student will be able to perform analysis of image processing algorithms using simulation tools.
CO2	Student will be able to Simulate the Interference Suppression
CO3	Able to understand and implement the Simulation of Point & line detection.
CO4	To understand and implement the Simulation of Linear and Circular convolution
CO5	Student will be able to Simulate DFT & DCT.
CO6	To understand and implement the Simulation of Image compression using JPEG standard

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H	M	H			M	M	L	H
	CO2	M	H	H	M	M			L	M	L	M
	CO3	M	H	H	M	M			L	M	L	M
	CO4	M	M	H	H	M			L	M	L	M
	CO5	M	H	M	H	M			M	H	M	H
	CO6	H	M	M	M	M			L	M	L	M
3	Category	Professional Core										
4	Approval	47th Meeting of Academic Council, Aug 2018										

SEMESTER II

P18PCDC201	**ADVANCED RF SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To impart the modeling of RF system design in the field of communication system
- To study about the characteristics of oscillators, mixers, PLL, wireless synthesizers and detector
- To design RF filter and RF amplifier circuits.

SYLLABUS

UNIT I RF ISSUES 9

Importance of RF design- Electromagnetic spectrum, RF behavior of passive components, chip components and circuit board considerations, scattering parameters, smith chart and applications.

UNITII RF FILTER DESIGN 9

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

UNIT III ACTIVE RF COMPONENTS AND APPLICATIONS 9

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

UNIT IV RF AMPLIFIER DESIGNS 9

Characteristics, amplifier power relations, stability considerations, constant gain circles, constant VSWR circles, low noise circles broadband, high power and multistage amplifiers.

UNIT V OSCILLATORS, MIXERS & APPLICATIONS 9

Basic oscillator model, High Frequency oscillator configuration, basic characteristic of mixers, wireless synthesizers, phase locked loops, detector and demodulator circuits.

TOTAL: 45PERIODS

TEXT BOOKS & REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2. Joseph. J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Third Edition, 2000.
3. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
4. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
5. Roland E. Best, Phase - Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003.

COURSE OUTCOMES (COs)	
CO1	To learn the importance and issues in the design of RF
CO2	To discuss RF Filter designing
CO3	To understand RF Active components
CO4	To understand RF Applications
CO5	To study RF transistor amplifier design
CO6	Oscillators and mixers used in RF design

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	M	H	M	M		L	M	M	L	M
	CO2	H	M	H	H	M		M	M	L	M	L
	CO3	L	L	L	M	M		M	H	M	M	L
	CO4	H	H	H	M	L		L	M	L	M	L
	CO5	H	M	H	H	M		M	L	L	M	M
	CO6	H	H	H	M	H		M	M	L	L	M
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCDC202	**ADVANCED WIRELESS COMMUNICATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

To enable the student to understand the evolving paradigm of cooperative and green wireless communication concepts and the challenges and trade-offs involved in such networks.

SYLLABUS

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations ; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management,

Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment , Cooperative multicell processing techniques for energy-efficient cellular wireless communications.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TEXT BOOKS:

1. EkramHossain, Dong In Kim, Vijay K. Bhargava , "Cooperative Cellular Wireless Networks", Cambridge University Press, 2011.
2. EkramHossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.
3. F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012.

REFERENCES:

1. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access", GRINVerlag, 2012.
2. Mohammad S. Obaidat, AlaganAnpalagan and Isaac Woungang, "Handbook of Green Information and Communication Systems", Academic Press, 2012.
3. Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers, 2010.
4.Jinsong Wu, SundeepRangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.

COURSE OUTCOMES (COs)	
CO1	The student would be able to appreciate the necessity and the design aspects of cooperative and green wireless communication.
CO2	The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
CO3	The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.
CO4	The student able to understand the different power saving strategies and energy efficient signal, system and network design.
CO5	The student expose the energy saving techniques adopted in existing wireless components, protocols and networks.
CO6	The Students will have the knowledge about the evolution of green future wireless communication technologies.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	K
	CO1	H			H	H						

2	CO2	H	H		H					M		M
	CO3	H	H		H	H				M		M
	CO4		M		H		M					
	CO5	M			M					H		
	CO6		H		H		L			H		M
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCDC2L3	**NETWORKING LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**0**	**0**	**4**	**2**
	Prerequisite – Computer communication and networks lab				
	Course Designed by – Department of Electronics & Communica Engineering				

Course Objective:

- To understand the functioning of various protocols in Wired and Wireless Environment.
- To perform real time experimentation using the existing infrastructure.
- To impart programming skill using NS2/QUALNET.
- Gain knowledge to construct LAN, WLAN, and VLAN in a real-time environment

LIST OF EXPERIMENTS:

1. Implement a simple TCP client – server where in a server acts as a time and date server.
2. Print a client address at server end.
3. Write a program in which a process is made to handle postfix signals.
4. Program a echo UDP server.
5. Create a daemon.
6. Create a simple chat program.
7. Create a simple out of band sending and receiving program.
8. Program to capture each packet and examine its checksum fields.

COURSE OUTCOMES (COs)	
CO1	Ability to design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.
CO2	To acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.
CO3	To acquire the ability to design WLAN/ LAN systems meeting out real time requirements
CO4	To understand and be able to explain security and ethical issues in computer networking

CO5	To be able to implement key networking algorithms in simulation.
CO6	Students can able to write the program to capture each packet

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	M		M
	CO2	H	M	H	M	H			M	H	M	
	CO3	M	M	M	H	M					M	H
	CO4	M	H	M	M	M			M	H		M
	CO5	M	H	H	H					M		L
	CO6	M	H	H	H	H			M	M	M	M
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

		L	T	P	C
P18PCDC2L4	**RF SYSTEM DESIGN LAB**				
	Total Contact Periods – 45	**0**	**0**	**4**	**2**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To enable the students to verify the basic principles and design aspects involved in high frequency communication systems components
- To expose the student to different high frequency components and conduct the experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts.
- To design and develop RF components using microstrip technology.

List of Experiments

1. Measurement of S parameters for a) Inductor b) Capacitor c) impedance matching circuits, filters using network analyzer
2. Design of λ/2, λ/4 micro strip transmission line.
3. Design of microstrip inductor and capacitor.
4. Design of impedance matching network.
5. Design of low pass, high pass, band pass and band stop filter at RF .
6. Design and characterization of micro strip patch antennas
7. Design and characterization of LNA

8. Design and characterization of Mixer
9. Design and characterization of VCO

COURSE OUTCOMES (COs)	
CO1	Apply knowledge to identify a suitable architecture
CO2	Comprehensively record and report the measured data, and would be capable of analyzing, interpreting the experimentally measured data
CO3	Design and develop microstrip filters.
CO4	To systematically design an RF system.
CO5	To produce the meaningful conclusions
CO6	To characterize different devices

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	L	H			H	M	L	H
	CO2	M	M	M	L	H			H	M	M	H
	CO3	L	M	M	L	H			H	M	L	H
	CO4	M	L	M	L	H			H	M	L	H
	CO5	M		S		S			S	M		S
	CO6											
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

PROFESSIONAL ELECTIVES

P18PCMA011	**ADVANCED MATHEMATICS FOR ELECTRONICS ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:NIL				
	Course Designed by : Dept of Mathematics				

OBJECTIVES

To apply all taught techniques to unseen problems, and queuing is a major branch of optimization, Random variable compute and interpret means, correlation/covariance, PERT and CPM chart is mainly used for documenting the

data(visually) on projects.

SYLLABUS

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 9

Random variables and their functions - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Exponential, Gamma, Weibull and Normal distributions.

UNIT II MATRIX THEORY 9

Eigen values using QR Transformations generalized eigenvectors – Canonical forms, singular valued composition and application – matrix norms and induced norms Psuedo inverse – least square approximations

UNIT III SPECIAL FUNCTIONS 9

Bessel's Equation- Bessel Functions- Legendre's Equation- Legendre Polynomials- Rodrigue's Formula- Recurrence Relations- Generating Functions and Orthogonal Property for Bessel Function of the First Kind.

UNIT IV OPERATIONS RESEARCH 9

Network Definitions – Minimal Spanning Tree algorithm – Shortest Route Problem – Maximal Flow model – Minimum Cost Capacitated Flow Problem – CPM and PERT.

UNIT V QUEUING THEORY 9

Single and Multiple Server Markovain Queuing Models – Customer Impatience Priority Queues M/g / I Queuing System –Queuing Applications.

TEXT BOOKS:

1. Handy A.Taha., "Operations Research An Introduction", 7th Edn. Pearson Education , Chennai-113. 2002.
2. Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 2nd Edn.
3. Wiley India Pvt Ltd, New Delhi.

R**EFERENCE BOOKS:**

1. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi. 1994.
2. Gupta.SC and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.
3. Stewart G.W. "Introduction to Matrix Computaions" Academic Press, New York.

COURSE OUTCOMES (COs)	
CO1	The student will learn to analyze and solve the fundamental problems with prescribed conditions in simple cases.
CO2	The student will learn to understand how signals, systems, inference combine in

	prototypical tasks of communication.
CO3	The student will learn to manipulate matrices and to do matrix algebra, determinants, Eigen values Eigen vectors and to solve the system of linear equations.
CO4	The student will learn to understand how signals, systems, control.
CO5	The student will learn to understand how signals, systems, signal processing.
CO6	The student will learn operation research methodology.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			H	H		H
	CO2	H	H	M	H	H			H	H	M	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	H	M	H				M	M	M	
	CO6	H	M	M	H	H			H	M		
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC012	**VEHICULAR AD HOC NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

COURSE OBJECTIVES:

- To give exposure to state of the art in VANETs
- To understand VANETs which now open new vistas for internet access, distributed gaming and the fast growing Mobile entertainment industry.
- To understand VANETs to promote Traffic Safety.

SYLLABUS:

Unit I: Introduction to Vehicular Ad Hoc Networks (VANETs) (6Hrs)

Traffic Monitoring, Causes of congestion, Traffic Monitoring Data, Common Applications of

Traffic Data, Commonly used sensor technology, Detection methods

Unit II : Models for Traffic flow and Vehicle Motion (8Hrs)
Models for Longitudinal Vehicle Movement, Lane changes situations, Simulating Vehicle-toVehicle and Infrastructure-to-Vehicle Communication

Unit III: Networking Issues (8Hrs)
Routing in MANET, Applicability of MANET Routing to Vehicular Environment, Routing protocols for VANET.

Unit IV: Delay-Tolerant Networks in VANETs (6Hrs)
Deterministic/Stochastic Delay-Tolerant Routing, Vehicle Traffic Model, Vehicle- Roadside Data Access, Data Dissemination in VANETs

Unit V: Localization in Vehicular Ad-Hoc Networks (6Hrs)
Localization-Aware VANET applications, Localization Techniques for VANETs, Data Fusion in VANET Localization Systems

Unit VI: Vehicular Applications (6Hrs)
Safety related vehicular applications, use of Infrastructure in VANETs, Vehicular Network Simulators, Vehicular Mobility Models.

Total Contact Hours: 40

Text Books:
1. Stephan Olariu, Michele C. Weigle, "Vehicular Networks from Theory to Practice", CRC Press.
2. HassnaaMoustafa and Yan Zhang, "Vehicular Networks: Techniques, Standards and Applications," Auerbach Publications, 2009.
3. Selected Papers about Vehicular Ad Hoc Networks (VANETs).

Reference Books:
1. C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols," Prentice Hall, 2004.
2. William Stallings, "Wireless Communications and Networks," Prentice Hall, 2004.

COURSE OUTCOMES (COs)	
CO1	Graduate students and practitioners who intend to do work in VANETs can work on key research challenges.
CO2	Get overview of simulation tools used in VANETs.
CO3	Students can learn the possible applications in the categories like safety and traffic management
CO4	Also students can learn about driver assistant systems
CO5	To find the best paths in terms of travel time and expenses
CO6	To study about Travel-related information
Mapping of Course Outcomes with Student Outcomes (SOs) (S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	M					M		L
	CO3			M	H							
	CO4	M			H		H			M		H
	CO5		M	H	H		M			M		
	CO6	M	M	H	M		H			H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

SYLLABUS

UNIT I INTRODUCTION TO MICROWAVE CIRCUITS 9

Definitions – Frequency Bands – Lumped versus Distributed Circuits - Behavior of finite length transmission lines – General Characteristics of PC Boards – Transmission Lines on PC Boards – Passives made from Transmission Lines – Resonators - Combiners, Splitters and Couplers .

UNIT II MATCHING NETWORKS AND FILTER DESIGN 9

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements, Filter design.

UNIT III AMPLIFIERS AND OSCILLATORS 9

Amplifiers: Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Low Noise Amplifier Design, Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.

UNIT IV MIXERS AND CONTROL CIRCUITS 9

Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers - Sub Harmonic Diode Mixers ,Microwave Diodes , Phase Shifters – PIN Diode Attenuators

UNIT V MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES 9

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip

Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

TEXT BOOKS &REFERENCES:

1. Thomas H.Lee, "Planar Microwave Engineering", Cambridge University Press, 2004

2. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, II Edition 2002

3. "Microwave Transistor Amplifiers – Analysis and Design", II Edition, Prentice Hall, New Jersy

4. RavenderGoyal, "Monolithic MIC; Technology & Design", Artech House, 1989.

COURSE OUTCOMES (COs)												
CO1	To understand and design Microwave Integrated circuits											
CO2	Able to design the Matching networks and filter in microwave communication											
CO3	To study the different types of oscillators and amplifiers in microwave communication											
CO4	To know the concepts of mixer and control circuits in microwave components											
CO5	To understand about Microwave IC design											
CO6	Students will demonstrate their knowledge by designing microwave 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	M	H	H	M	M			L	L	M	M
	CO2	M	H	H	M	L			M	M	M	L
	CO3	M	H	H	M	L			L	L	L	M
	CO4	M	M	H	M	M			L	L	M	L
	CO5	H	M	M	M	L			M	L	M	M
	CO6	H	M	M	H	L			L	M	L	L
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC021	ASIC DESIGN	L	T	P	C
	Total Contact Hours –45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To learn the fundamentals of ASIC and its design methods

SYLLABUS

UNIT – I INTRODUCTION TO ASIC, CMOS LOGIC AND ASIC LIBRARYDESIGN 9

Capacitance – Logical Effort – Library Cell Design – Library Architecture Types of ASIC **–** Design Flow – CMOS Transistors – CMOS Design Rules – Combinational Logic Cell – Sequential Logic Cell – Data Path Logic Cell – Transistors as Resistors – Transistor Parasitic**.**

UNIT –II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS. 9

Anti fuse – Static RAM – EPROM and EEPROM Technology – PREP Bench Marks – Acted ACT – Xilinx LCA – Altars FLEX – Alters MAX – DC & AC Input and Output – Clock and Power Input – Xilinx I/O Blocks.

UNIT – III PROGRAMMABLE ASICS INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY. 9

Acted ACT - Xilinx LCA - Xilinx EPLD - Alters MAX 5000 & 7000 - Alters MAX 9000 - Alters FLEX – Design System – Logic Synthesis – Half Gate ASIC – Schematic Entry – Low Level Design Language – PLA Tools – EDIF – CFI Design Representation**.**

UNIT – IV LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Verilog and Logic Synthesis– VHDL and LOGIC Synthesis– Types of Simulation – Boundary Scan Test– Fault Simulation- Automatic Test Pattern Generation.

UNIT–V ASICS CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING. 9

System Partition – FPGA Partitioning – Partitioning Methods – Floor Planning – Placement – Physical Design Flow – Global Routing – Detailed Routing – Special Routing –Circuit Extraction – DRC.

TEXT BOOK:

1. M. J. S. Smith, “Application Specific Integrated Circuits” , Addison – Wesley L Ongnam Inc., 1997.

REFERENCE BOOK:

1. Andrew Brown, “VLSI Circuits and Systems in Silicon”, McGraw Hill 1991.
2. S. D. Brown, R. J. Francis, J. ROX, Z. G. Urines, “Field Programmable Publishers, 1992.

3. Mohammed Ismail and Terri Fief, “Analog VLSI and Modern Signal Processing,” McGraw Hill 1994.
4. S. Y. Kang, H. J. While Hours, T. Kailath, “VLSI Modern Signal Processing,” Prentice Hall, 1985. Jose E. France, Yantis Tsividis, “Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing”, Prentice Hall, 1994.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge about CMOS design rules and ASIC cell libraries
CO2	To gain knowledge on programmable architectures for ASICs
CO3	To gain knowledge on programmable interconnect for ASICs
CO4	To understand about logic synthesis
CO5	To understand about testing methods
CO6	To understand the Asics Construction, Floor Planning, Placement And Routing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H		M				M		M
	CO2	M	H	H		M			H	H	H	H
	CO3	M		M		M			M		M	
	CO4	H	H		H					H		H
	CO5	H	H		H				M	M		
	CO6	M	H	H	H	H			H	H	H	H
	Category	Professional Elective(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC022	**NON – LINEAR SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- The student understands Maximum Likelihood estimation, point and scale estimation.
- The student is familiar with binary and colour image processing basics.
- The student can handle median based operations.
- The student has knowledge about sorting operations.
- The student can explain various implementation technologies.

SYLLABUS:

UNIT ILINEAR SIGNAL PROCESSING AND STATISTICAL PRELIMINARIES 9
Random Variables and Distributions – Estimation – Point Estimation – Maximum likelihood Estimators – M-Estimators – L-Estimators – R-Estimators – Scale Estimation - Noise Models.

UNIT IIBINARY IMAGE AND COLOUR IMAGE PROCESSING 9
Introduction – Morphological Image Processing –Standard Binary morphological operations – Dilation and Erosion based operations. Introduction to colour image processing – Light and colour – Colour formation – Human perception of colour – Colour Model – the Chromaticity Diagram – Colour image Quantization – Histogram of a Colour image – Colour image Filtering – Pseudo-Colouring – colour image segmentation.

UNIT III INTRODUCTION TO NON LINEAR FILTERS 9
Nonlinear filters – Measures of robustness – Order Statistics Filters – Median filters and their characteristics – Impulse noise filtering by median filters – Recursive and weighted median filters –Decision based filters – Switched Median filters.

UNIT IV ALGORITHMS 9
Sorting and Selection Algorithm – Running Median Algorithm – Bitonic sort – Bubble sort and its variant – Shellsort – Quick sort – Bucket and Sample sort – Enumeration sort and Radix sort.

UNIT V ARCHITECTURE AND APPLICATIONS OF NONLINEAR FILTERS 9
Basic structure for order statistics filtering – Systolic array implementation – Wavefront array implementation – General nonlinear filter structure – Signal dependent noise filtering – Computational complexity of general nonlinear filter model – Nonlinear Edge Detection – Implementation of decision logics.

TOTAL :45 PERIODS

TEXT BOOKS:

1. Gonzalo R. Arce,"Nonlinear Signal Processing: A Statistical Approach", Wiley-Interscience, 2004.
2. S. K Mitra, "Nonlinear Image Processing ", Academic Press, 2000

REFERENCES

1. Loannis Pitas, Anastasios N. Venetsanopoulos,"Nonlinear digital filters: principles and applications", Springer, 1990 – Technology & Engineering.

COURSE OUTCOMES (COs)	
CO1	Derive Maximum Likelihood criterion in the least square sense.
CO2	Define the rules and standards for binary
CO3	Describe different sorting algorithms.
CO4	Design simple median based filters.
CO5	Develop different architecture schemes for nonlinear filters
CO6	Define the rules and standards for colour image processing

	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				M					
	CO2	M			H	M				M		
	CO3		M									L
	CO4	L							L			
	CO5			L	M			M			M	
	CO6											
3	Category		Professional Electives(PE)									
4	Approval		47th Meeting of Academic Council, Aug 2018									

2.

		L	T	P	C
P18PEDC023	**WIRELESS SECURITY AND CELLULAR MOBILE COMMUNICATION**				
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- To introduce the concepts of wireless / mobile communication using cellular environment.
- To make the students to know about the various modulation techniques, propagation methods, coding and multi access techniques used in the mobile communication.
- Various wireless network systems and standards are to be introduced.

SYLLABUS:

UNIT I SERVICES AND TECHNICAL CHALLENGES 9

Types of Services, Requirements for the services, Multipath propagation, Spectrum Limitations, Noise and Interference limited systems, Principles of Cellular networks, Multiple Access Schemes.

UNIT II WIRELESS PROPAGATION CHANNELS 9

Propagation Mechanisms (Qualitative treatment), Propagation effects with mobile radio, Channel Classification, Link calculations, Narrowband and Wideband models.

UNIT III WIRELESS TRANSCEIVERS 9

Structure of a wireless communication link, Modulation and demodulation – Quadrature Phase Shift Keying, □/4-Differential Quadrature Phase Shift Keying, Offset-Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum Shift Keying, Gaussian Minimum Shift Keying, Power spectrum and Error performance in fading channels.

UNIT IV SIGNAL PROCESSING IN WIRELESS SYSTEMS 9

Principle of Diversity, Macrodiversity, Microdiversity, Signal Combining Techniques, Transmit diversity, Equalisers- Linear and Decision Feedback equalisers, Review of Channel coding and

P18PEDC031	IMAGE PROCESSING AND PATTERN RECOGNITION	L	T	P	C

Speech coding techniques.

UNIT V ADVANCED TRANSCEIVER SCHEMES 9

Spread Spectrum Systems- Cellular Code Division Multiple Access Systems- Principle, Power control, Effects of multipath propagation on Code Division Multiple Access, Orthogonal Frequency Division Multiplexing – Principle, Cyclic Prefix, Transceiver implementation, Second Generation(GSM, IS–95) and Third Generation Wireless Networks and Standards

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
2. Simon Haykin& Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.

REFERENCES:

1. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
2. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

COURSE OUTCOMES (COs)	
CO1	To demonstrate the principle of trunking efficiency and how trunking and interference issues between mobile and base stations combine to affect the overall capacity of cellular systems.
CO2	To deal with the fundamental cellular radio concepts such as frequency reuse and handoff.
CO3	To also deals with the different types of equalization techniques and diversity concepts
CO4	To provide idea about analog and digital modulation techniques used in wireless communication.
CO5	To study various protection systems in trans receiver systems
CO6	To analyze third generation systems

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				M					
	CO2	M			H	M				M		
	CO3		M									L
	CO4	L							L			
	CO5			L	M			M			M	
	CO6											
3	Category		Professional Electives(PE)									
4	Approval		47th Meeting of Academic Council, Aug 2018									

	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NON LINEAR SIGNAL PROCESSING				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

This course emphasizes general principles of image processing. Topics such as image enhancement, im restoration, image segmentation and image compression are covered. Some concepts of pattern recogni are also introduced in this course.

COURSE OUTCOMES (COs)

SYLLABUS:

UNIT –I FUNDAMENTALS OF DIGITAL IMAGE FORMATION 9

Elements of Visual perception – A simple Image Model – Sampling and Quantization – Some Basic Relationship between Pixels.

UNIT-II IMAGE TRANSFORMS 9

Two Dimensional Orthogonal and Unitary Transforms – Properties of Unitary Transforms – One Dimensional DFT – Two Dimensional DFT – Cosine Transforms – Sine transforms – Hadamard Transforms – Haar Transforms – Slant transforms.

UNIT-III IMAGE ENHANCEMENT 9

Point Operations – Histogram Modeling – Spatial Operations – Transform Operations. Gray level transformation techniques- Spatial domain techniques - Half toning, Median filtering, contrast stretching, Histogram Equalization-

UNIT-IV IMAGE RESTORATION AND COMPRESSION 9

Image observation models – Inverse and Wiener Filtering – Pixel Coding – Predictive techniques – Transform Coding of Images. Source coding techniques - Run length coding - Shannon-Fano coding- Huffman coding- Arithmetic coding- LZW coding - Transform and Predictive compression methods - Vector quantization- case studies - JPEG-MPEG.

UNIT-V INTRODUCTION TO PATTERN RECOGNITION 9

Elements of Image Analysis, Introduction to pattern classification Feature selection and extraction, Supervised and Unsupervised Parameter estimation Basic concepts- Structure of a typical pattern recognition system Feature vectors , Feature spaces , Pattern classification by distance functions - Minimum distance classification – Cluster algorithms

TEXT & REFERNCES:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Reprint, 2008.
2. R. O. Duda, P. E. Hart, D. G. Stork, Pattern Classification, 2nd edition, John Wiley & Sons, Inc., 2000.
3. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall of India, New Delhi, 2001.
4. Image processing, Analysis, and Machine vision by Milan Sonka, Vaclav Hlavac Roger Boyle, Vikas Publishing House.
5. S. Theodoridis, K. Koutroumbas, Pattern Recognition, 4th edition, Academic Press, 2009.

CO1	To introduce students the fundamentals of image formation.
CO2	Identify and describe operation of different smoothing and sharpening filters.
CO3	Students are able to analyze the different segmentation techniques
CO4	Students are able to apply different de-noising models to recover original image.
CO5	To develop an appreciation for various issues in the design of computer vision and object recognition systems.
CO6	To provide the student with programming experience from implementingcomputer vision and object recognition 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
2	CO1	M	L	L	H	H		L	H	H	M	H
	CO2	M	L	H	H	H		L	H	H	M	H
	CO3	M	L	L	H	H		L	H	H	M	H
	CO4	M	L	L	H	H		L	H	H	M	H
	CO5	M	H	H	H	H		L	H	H	M	H
	CO6	M	M	H	H	H		L	H	H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC032	**OPTICAL COMMUNICATION SYSTEM AND NETWORKING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite –MODERN DIGITAL COMMUNICATION SYSTEMS				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:
To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.

SYLLABUS

UNIT I OPTICAL NETWORK ARCHITECTURES **9**
Introduction to Optical Networks; Layered Architecture- Spectrum partitioning, Network Nodes,

Network Access Stations, Overlay Processor, Logical network overlays.

UNIT II NETWORK CONNECTIONS AND THE CONTROL PLANE 9

Connection Management and Control; Static and Wavelength Routed Networks; Linear Light wave networks; Logically Routed Networks; Traffic Grooming; The Optical Control Plane- Architecture, Interfaces, Functions; Generalized Multiprotocol Label Switching – MPLS network and protocol stack, Link management, Routing and Signaling in GMPLS.

UNIT III ROUTING AND WAVELENGTH ASSIGNMENT 9

Static Multipoint network –Shared media and multiple access, Scheduling and Optical, Spectral Efficiency, Traffic constraints, Passive Optical Networks; Wavelength Routed Networks – Static and Dynamic Routing and Wavelength Assignment, Linear Lightwave networks - Static and Dynamic Routing and Wavelength Assignment.

UNIT IV OPTICAL PACKET SWITCHED NETWORKS 9

Network Architectures- Unbuffered Networks, Buffering Startegies; OPS enabling technologies, Testbeds; Optical Burst Switching, Switching protocols, Contention Resolution, Optical Label Switching, OLS network testbeds.

UNIT V NETWORK MANAGEMENT AND SURVIVABILITY 9

Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

TOTAL: 45 PERIODS

TEXT &REFERENCES:

1. Thomas E. Stern, GeorgiosEllinas, Krishna Bala, “Multiwavelength Optical Networks – Architecture, Design and control “, Cambridge University Press, 2nd Edition, 2009.
2. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical Perspective”, Harcourt
Asia Pte Ltd., Second Edition 2006.
3. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks : Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
5. Biswanath Mukherjee, “Optical WDM Networks”, Springer, 2006.

COURSE OUTCOMES (COs)	
CO1	To understand the concepts of Spectrum partitioning, Network Nodes, Network Access Stations
CO2	To enable the student to understand the differences in the design of data plane and the control plane and the routing , switching and the resource allocation methods and the network management and protection methods in vogue.
CO3	To expose the student to the advances in packet switching in the optical domain, the associated challenges and the possible solution approaches.

CO4	To use the concepts of Connection Management and Control, Traffic Grooming and the Op Control Plane.
CO5	To understand the concepts of Network Architectures and Unbuffered Networks
CO6	To understand the concepts of Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			H	H						
	CO2	H	H		H	H				M		M
	CO3	H	H		H	H				M		M
	CO4		M		M		H			M		
	CO5	M								H	M	
	CO6						L			H		M
3	Category	Professional Elective(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC033	**GLOBAL TRACKING AND POSITIONING SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:NIL				
	Course Designed by: – Department of Electronics & Communication Engineering				

Course Objectives:

- There have only been limited analyses on how key parameters vary across various GPS devices.
- To examine the capabilities and accuracy of several commercially-available portable GPS devices.
  To assess their feasibility for human time-activity tracking in air pollution epidemiological studies. When compared to the previous studies, we focus more on challenging locations that often raise problems in studies that need continuous time activity profiles.

SYLLABUS

UNIT I INTRODUCTION **9**

GPS and GLONASS Overview – Satellite Navigation – Time and GPS – User Position and Velocity Calculations – GPS – Satellite Constellation – Operation Segment – User Receiving Equipment – Spacing Segment Phased Development.

UNIT II SIGNAL CHARACTERISTICS **9**

GPS signal component – purpose. Properties and power level – signal acquision and tracking – Navigation information extraction – pseudorange estimation – frequency estimation – GPS satellite position calculation.

UNIT III GPS RECEIVERS AND DATA ERRORS 9

Receiver Architecture – Receiver design Options – Antenna design – SA errors – Methods of Multipath mitigation – Ephemeris data errors – Clock errors.

UNIT IV DIFFERENTIAL GPS 9

Introduction – LADGPS – WADGPS, Wide area Augmentation Systems – GEO uplink Subsystem – GEO downlink Systems – Geo Orbit Determination – Geometric analysis – covariance analysis – GPS / INS Integration Architectures.

UNIT V GPS APPLICATIONS 9

GPS in Surveying, Mapping and Geographical Information System – Precision Approach Aircraft landing system – military and space application – intelligent transportation system

Total Periods: 45

TEXT BOOKS:

1. Mohinder S. Grewal, Lawrence R. Weill, Angus P. Andrews, "Global Positioning System – Inertial Navigation and Integration", John Wily & Son, 2001.
2. E.D. Kaplan, "Understanding GPS Principles and applications", Arctech house Boston 1996.

REFERENCE BOOK

1. Hofmann-Wellenhof**,** B.**,** Lichtenegger**,** H.**,** Collins**,** J, "Global Positioning System", Printice hall,2009.
2. James J. Spilker Jr.; PeninaAxelrad; Bradford W. Parkinson; Per Enge, "Global Positioning System: Theory and Applications, American Institute of Aeronautics and Astronautics, 1996.

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Explain the workings of GPS, and understand the acquisition of locational data using the hardware
CO2	Produce a simple map from field data acquired using hand-held GPS.
CO3	The candidate shall have an in-depth understanding of satellite positioning and navigation, especially American GPS
CO4	The candidate shall have obtained ability to work independently and in a te towards relevant research front in Global positioning and navigation systems
CO5	Ability to identify the global positioning satellite data interface and relation v other related disciplines, ability to understand the international perspective satellite positioning
CO6	GPS in Surveying, Mapping and Geographical Information System

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	H	H	M	H			H	M	H	H
	CO2	H	M	M	H	H			H	H	M	H

	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	M	H	M	H				M	M	M	H
	CO6	H	M	M	H	H			M	M		H
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC041	**MODELING AND SIMULATION OF COMMUNICATION NETWORKS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- Learn modeling and simulation
- Understand Monte Carlo simulation
- Study channel modeling and mobility modeling

SYLLABUS

UNIT I -INTRODUCTION TO MODELING AND SIMULATION 9

Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.

UNITII MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT III -LOWER LAYER & LINK LAYER WIRELESS MODELING 9

Physical Layer Modeling, Description of the Main Components of the PHY Layer, Accurate Simulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queueing and Processing Delay.

UNIT IV CHANNEL MODELING & MOBILITY MODELING 9

Channel Modeling :The Physics of Radiation, The Nature of Electromagnetic Radiation, Classification of Propagation Models, Deterministic Approaches by Classical Field Theory,

Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, Stochastic Shadowing Models, Stochastic Fading Models, MIMO Channel Models. Mobility modeling :Categorization of Mobility Models, Mobility Models, Random Walk Model, Random Waypoint Model, Random Direction Model, Gauss-Markov Model, Manhattan Model, Column Model , Pursue Model, Nomadic Community Model, Selection of Appropriate Mobility Models

UNIT V HIGHER LAYER MODELING & MODELING THE NETWORK TOPOLOGY9

Higher Layer Modeling :Modeling the Network Layer and Routing Protocols, Components of a Routing Protocol, Metrics, Virtual Routing on Overlays, Modeling Transport Layer Protocols, Modeling Application Traffic. Modeling the Network Topology : Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Geometric Random Graphs – The Waxman Model, Hierarchical Topologies, Preferential Linking – The Barabási-Albert Model , Modeling the Internet.

TOTAL: 45PERIODS

TEXT BOOKS & REFERENCES:

1. Irene Karzela, "Modeling and Simulating Communications Networks", Prentice Hall India, 1998.
2. K.Wehrie. Gunes, J.Gross, "Modeling and Tools for Network simulation", Springer, 2010.
3. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, "Simulation of Communication Systems: Modeling, Methodology and Techniques", Plenum Press, New York, 2001.
4. Nejat; Bragg, Arnold, "Recent Advances in Modeling and Simulation Tools for Communication Networks and Services", Springer, 2007
5. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation", Pearson Education (Singapore) Pvt. Ltd, 2004.

COURSE OUTCOMES (COs)	
CO1	To learn basics of Modeling And Simulation of communication networks
CO2	To gain knowledge to apply Monte Carlo simulation
CO3	To discuss Lower Layer and Link Layer Wireless Modeling
CO4	To compare channel modeling and mobility modeling
CO5	To understand the concept of Higher Layer Modeling
CO6	To understand the concept of Modeling the Network Topology

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	H	H	M	L		L	H	M	L	M
	CO2	L	H	M	L	M		M	L	L	M	M
	CO3	H	M	H	H	M		L	M	M	L	L
	CO4	H	M	H	M	M		L	L	L	M	M
	CO5	H	M	H	M	L		M	L	L	M	L

	CO6	M	L	M	H	M		M	H	M	L	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC042	**HARDWARE AND SOFTWARE CO-DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To acquire the knowledge about system specification and modeling.
- To learn the formulation of partitioning
- To analyze about co-synthesis.
- To study the different technical aspects about prototyping and emulation.
- To formulate the design specification and validate its functionality by simulation

SYLLABUS

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modelling , Co-Design for Heterogeneous Implementation – Processor Synthesis Single-Processor Architectures with one ASIC, Single-Processor Architectures with many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation ,Requirements for Embedded System Specification.

UNIT II HARDWARE/SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem , Optimization , HW /SW Partitioning based on Heuristic Scheduling, HW /SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments,Future Developments in Emulation and Prototyping ,Target Architecture-Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level

Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL:45 PERIODS

TEXT &REFERENCES:

1. Ralf Niemann , "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne W olf ,"Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub,1997.
3. Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design" Kaufmann Publishers,2001.

COURSE OUTCOMES (COs)	
CO1	Designing and modeling of Single-Processor Architectures
CO2	To analyze hardware and software partitioning
CO3	To analyze hardware and software co-synthesize
CO4	To study about Prototyping and Emulation Techniques
CO5	Designing and Representation for System Level Synthesis
CO6	Design specifications and validate its functionality by simulation

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	M	H	M	L			L	L	L	M
	CO2	L	L	L	M	M			M	L	L	L
	CO3	H	L	H	M	M			M	L	L	L
	CO4	L	L	L	M	M			M	L	L	L
	CO5	H	M	H	M	L			L	L	L	M
	CO6	H	M	H	M	L			L	L	L	M
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC043	**ADVANCED CRYPTOGRAPHY AND NETWORK SECURITY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				

	Course Designed by – Department of Electronics & Communication Engineering

OBJECTIVES:

- To study various aspects of Network Security Attacks, Services and Mechanisms.

SYLLABUS

UNIT I -INTRODUCTION 9

Security Services, Mechanisms and Attacks – Network Security Model-Classical Encryption Techniques – Steganography – Data Encryption Standard (DES)

UNITII ADVANCED BLOCK CIPHERS AND PUBLIC KEY CRYPTOSYSTEMS 9

Block cipher modes operation – Overview of IDEA, Blowfish, RC5, CAST-128 – Characteristics of advanced symmetric Block ciphers – Key Distribution – Principle – RSA algorithm – Public Key Management – DiffieHellmen Key Exchange – X.509 Public Key Certificate Format.

UNIT III -MESSAGE AUTHENTICATION AND DIGITAL SIGNATURE 9

Message Authentication codes – MAC – HASH function – Principle of MD5, SHA-1 and HMAC algorithms-Digital Signature algorithm.

UNIT IV NETWORK SECURITY 9

Authentication Application – Kerbros – Email Security – PGP – Network Security – IPSec – Web Security – SSL – SET.

UNIT V CRYPTOGRAPHIC AND SECURITY IMPLEMENTATIONS

Intrusion Detection – Password management – Malicious software – Viruses and countermeasures – Firewall Types and Configurations – Trusted System.

TOTAL: 45PERIODS

TEXTBOOKS &REFERENCES:

1. William Stallings, "Cryptography and Network Security", Pearson Education, 5th Edition, New Delhi, 2011.
2. Forouzan.B.A. andMukhopadhyay.D, "Cryptography and Network Security", Tata Mc-Graw Hill, 2nd Edition, 2010.
3. William Stallings, "Cryptography and Network Security", PHI, New Delhi, 2nd Edition, 1999.

COURSE OUTCOMES (COs)	
CO1	To understand the mathematical concepts of various Encryption, Authentication and Digital Signature Algorithms.
CO2	To standby the design of different general purpose and application specific security Protocols and standards.
CO3	To understand the concepts of Message Authentication
CO4	To study about various digital signature algorithm
CO5	To gain knowledge about various types of Network security
CO6	To gain knowledge about various types of system security

Mapping of Course Outcomes with Student Outcomes (SOs) (S/M/L 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	H	M	H	M	L			L	L	L	M
	CO2	L	L	L	M	M			M	L	L	L
	CO3	L	L	L	M	M			M	L	L	L
	CO4	H	L	H	M	M			M	H	L	H
	CO5	L	L	L	M	M			M	H	L	H
	CO6	L	L	L	M	M			M	H	L	L
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEDC051	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:NIL				
	Course Designed by: – Department of Electronics & Communication Engineering				

Course Objectives:

- To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
- To understand EMI sources and its measurements.
- To understand the various techniques for electromagnetic compatibility

SYLLABUS

UNIT I EMI ENVIRNONMENT **6**

Sources of EMI, Conducted and radiated EMI, Transient EMI, EMI – EMC Definition and units of Parameters.

UNIT II EMI COUPLING, PRINCIPLES **9**

Conducted, Radiated and Transient coupling, Common impedance ground coupling radiation common mode and ground loop coupling, radiated differential mode coupling near Field, cable to cable Coupling, power mains and power supply coupling.

UNIT III EMI SPECIFICATIONS / STANDARDS / LIMITS **7**

Units of specifications civilian standard, military standards.

UNIT IV EMI MEASUREMENTS **7**

EMI test instruments / systems, EMI test / EMI shielded chamber, open area test site, TEM cell antennas, conductors sensors / injectors / couplers, military test method and procedures, calibration procedures.

UNIT V EMI CONTROL TECHNIQUES **7**

Shielding, filtering, grounding, bonding, isolation transformation, transient suppressor, cable routing, signal control, component selection and mounting.

EMC DESIGN OF PCB'S **9**

PCB traces crosstalk, impedance control, power distribution decoupling, zoning, mother board design and propagation delay models.

Total Periods: 45 Hours

Textbooks:

1. Bernard Keiser, "Principles of EMC" ,Artech House, 3rd, 1986.
2. Henry W. Ott "Noise Techniques in electronics systems" Willey and sons, New York, 1998.
3. B.P Kodali, "Engineering EMC Principles, Measurements and technologies", IEEE Press, 1996.

REFERENCE BOOK

1. Christos christopoulos ,Principles and Techniques of Electromagnetic Compatibility, CRC Press, 2 edition (21 June 2007).

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Real-world EMC design constraints and make appropriate tradeoffs to achieve the most cost-effective design that meets all requirements
CO2	Designing electronic systems that function without errors or problems related to electromagnetic compatibility
CO3	Diagnose and solve basic electromagnetic compatibility problems
CO4	To be able to apply Maxwell's equations for electromagnetic systems.
CO5	To able to design systems to mitigate the effects of Electromagnetic Interference
CO6	To design systems with Electromagnetic compatibility

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			M	H	H	M
	CO2	M	H	M	H	M			M	M	H	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	M	H	M	H			H	H	M	H
	CO6	H	M	M	H	H			M	M		H
3	Category	Professional Elective (PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

SYLLABUS:

UNIT I HOURS CHARACTERIZATION OF DISTRIBUTED SYSTEMS: 9

Introduction, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges, Case study: The World Wide Web. SYSTEM MODELS: Introduction,

P18PEDC052	**DISTRIBUTED PROCESSING AND NETWORKING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES The aim of the course is that students will develop knowledge and understanding of Real-time requirements and performance optimization, Distributed systems concepts					

Physical models, Architectural models, Fundamental models.

UNIT II HOURS REMOTE INVOCATION: 9

Introduction, Request-reply protocols, Remote procedure call, Remote method invocation, Case study: Java RMI. DISTRIBUTED OBJECTS AND COMPONENTS: Introduction, Distributed objects, Case study: CORBA, from objects to components, Case studies: Enterprise JavaBeans and Fractal.

UNITIII HOURS DISTRIBUTED FILE SYSTEMS: 9

Introduction, File service architecture, Case study: Sun Network File System, Case study: The Andrew File System. NAME SERVICES: Introduction, Name services and the Domain Name System, Directory services. TIME AND GLOBAL STATES: Introduction, Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states, distributed debugging.

UNITIV HOURS COORDINATION AND AGREEMENT: 9

Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems. TRANSACTIONS AND CONCURRENCY CONTROL: Introduction, Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

UNITV HOURS DISTRIBUTED TRANSACTIONS: 9

Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. REPLICATION: Introduction, System model and the role of group communication, Fault-tolerant services, Case studies of highly available services: The gossip architecture, Bayou and Coda, Transactions with replicated data.

TEXT BOOK& REFERENCES:

1. Distributed Systems Concepts and Design: George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Fifth Edition, Pearson, M.Addison Wesley Co1987.

P18PEDC053	**ADVANCED RADIATION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –NIL				

COURSE OUTCOMES (COs)	
CO1	Ability to know about the distributed environment
CO2	Ability to know about the functionalities of file management system.
CO3	To know the concepts of Organize processes in distributed systems.
CO4	Students will be able to demonstrate the access of remote objects for the service.
CO5	To know about the Concept of Domain Name Distributed Locks.
CO6	Students will be able to learn about the operating system issues

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	L	L	H	H		L	H	H	M	L
	CO2	M	M	L	H	H		L	H	H	M	H
	CO3	M	L	M	H	H		L	H	H	M	L
	CO4	M	L	L	H	H		L	H	H	M	H
	CO5	M	L	L	H	H		L	H	H	M	L
	CO6	M	L	L	H	H		L	H	H	M	L
3	Category	Professional Elective (PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

	Course Designed by – Dept. of Electronics And Communication Engineering

OBJECTIVES

- Introduction to Radiation Protection
- Interaction of X-Radiation with Matter
- Radiation Quantities and Units
- Radiation Monitoring
- Equipment Design for Radiation Protection

SYLLABUS:

UNIT I BASICS CONCEPT OF RADIATION 9

Radiation from surface current and current line current distribution basic antenna parameter, Radiation mechanism – current distribution of antennas, impedance concept – balance, unbalanced transformer.

UNIT II RADIATION FROM APERTURES 9

Field equivalence principle, Rectangular and circular apertures, uniform distribution on an infinite ground plane aperture fields of horn antenna – Babinets principle, Geometrical theory of diffraction, reflection antennas, design considerations, slot antennas.

UNIT III SYTHESIS OF ARRAY ANTENNAS 9

Types of linear arrays, Current distribution in linear arrays, phased arrays, optimization of array patterns, continuous aperture sources, antenna synthesis techniques.

UNIT IV MICROSTRIP ANTENNAS 9

Radiation mechanism, feeding structure, rectangular patch, circular patch, ring antenna, input impedance of patch antennas, microstrip dipole, microstrip arrays.

UNIT V EMI / EMC / ANTENNA MEASUREMENTS 9

Log periodic, Biconical, log apiral ridge guide. Multi turn loop, traveling wave antenna, antenna measurement and instrumentation, amplitude and phase measurements, gain, directivity, impedance and polarization measurements. Antenna range.Design and evaluation.

Total Period: 45

TEXTBOOK:

1. Kraus. J. D "Antennas", 2nd edition John Wiley and sons, 1997

REFERENCE BOOKS:

1. Balansis. A. "Antenna Theory analysis and design" John Wiley and sons. New York 1982
2. Collin. R. E and Zucker "E" Antenna theory part I McGraw Hill, New York 1969.

COURSE OUTCOMES (COs)	
CO1	Students demonstrate their knowledge of advanced radiation measurements techniques
CO2	Students will communicate in writing their insights into radiation applications
CO3	Explain the various current mirror circuits and analyze differential amplifier with activeload
CO4	Describe thecharacteristics,linear and non linear application of operational amplifier
CO5	Analyze the internal modules of PLL, AnalogMultiplier and review its applications
CO6	Evaluate the characteristics of resonators.

	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	l
2	CO1	M	H				M						
	CO2				H	M				M			
	CO3		M					L				L	
	CO4	L								L			M
	CO5	H	H	L	M			M			M		
	CO6						H						
3	Category		Professional Elective (PE)										
4	Approval		47th Meeting of Academic Council, Aug 2018										

OPEN ELECTIVES

P18OEDC001	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Module 1 **9 Hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 **9 Hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear

Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 **9 Hours**

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module 4 **9 Hours**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module 5 **5 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module 6 **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

18OEPSDCO2 **INDUSTRIAL SAFETY**

P18OEMA002	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

1. To study about the industrial safety and types.

2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

Module 1 **9 Hours**

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.

Module 2 **9 Hours**

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.

Module 3 **9 Hours**

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

Module 4 **9 Hours**

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.

Module 5 **9 Hours**

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

Total No. of Periods: 45

References Books:

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.

OPERATIONS RESEARCH

P18OEME003	OPERATIONS RESEARCH	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

Module 1 **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module 2 **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3 **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 4 **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5 **9 Hours**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module 1: 9 Hours

Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module 2: 10 Hours

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module 3:10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 4: 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation

problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineeri				

Module 1 **9 Hours**

Introduction

Definition – Classification and characteristics of Composite materials.Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2 **9 Hours**

Reinforcements

Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module 3 **9 Hours**

Manufacturing of Metal Matrix Composites

Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module 4 **9 Hours**

Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and

applications.

Module 5 **9 Hours**

Strength

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

WASTE TO ENERGY

P18OEEE005	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

Module 1 **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2 **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3 **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

	Course Designed by – Department of Electrical & Electronics Engineering

Module 4 **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5 **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 & AUDIT 2

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title

SYLLABUS:

UNIT I: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and

Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness.

UNIT II: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

UNIT III: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT IV: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

UNIT V: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

	AUDIT: DISASTER MANAGEMENT	**L**	**T**	**P**	**C**
P18ACCE002	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I: **4 Hours**

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II: **4 Hours**

Repercussions Of Disasters And Hazards: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: **4 Hours**

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV: **4 Hours**

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **4 Hours**

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI: **4 Hours**

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNIC KNOWLEDGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives
To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
Learning of Sanskrit to improve brain functioning.
Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III: **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-BhartiPublication,New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output
Students will be able to

Understanding basic Sanskrit language

Ancient Sanskrit literature about science & technology can be understood.

Being a logical language will help to develop logic in students

P18ACBA004	**AUDIT : VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to

Understand value of education and self- development.

Imbibe good values in students.
Let the should know about the importance of character.

SYLLABUS:

UNIT I: **4 Hours**

Values and self-development –Social values and individualattitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.Valuejudgements

UNIT II: **6 Hours**

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, CleanlinessHonesty, Humanity.Power of faith, National Unity.Patriotism. Love for nature, Discipline.

UNIT III: **6 Hours**

Personality and Behavior Development - Soul and Scientificattitude.Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.HappinessVs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

UNIT IV: **6 Hours**

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality ,Non violence ,Humility, Role of Women.All religions and same message.Mind your Mind ,Self-control.Honesty, Studying effectively.

Suggested reading

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	**AUDIT: CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS:

UNIT I: **4 Hours**

History of Making of the Indian Constitution: HistoryDrafting Committee, (Composition & Working)

UNIT II: **4 Hours**

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III: **4 Hours**

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**

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of MinistersJudiciary, 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, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

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.

Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	**AUDIT : PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I: **4 Hours**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and Searching.

UNIT II: **2 Hours**

Thematic overview:Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

UNIT III: **4 Hours**

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: **4 Hours**

Professional development:: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V: **2 Hours**

Research gaps and future directions: Researchdesign,Contexts,Pedagogy Teacher education**,**Curriculum and assessment,Dissemination and research impact.

Suggested reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
- ✓ Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- ✓ Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- ✓ Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
- ✓ Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- ✓ www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- ✓ What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

  What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

  How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT: STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To achieve overall health of body and mind

To overcome stress

SYLLABUS:

UNIT I: **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II: **8 Hours**

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

Develop healthy mind in a healthy body thus improving social health also

Improve efficiency

P18ACBA008	**AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To learn to achieve the highest goal happily

To become a person with stable mind, pleasing personality and determination

To awaken wisdom in students

SYLLABUS:

UNIT I: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

UNIT II:

Approach to day to day work and duties.**8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35

Chapter 18-Verses 45, 46, 48.

UNIT III: **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested reading

"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students

CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

M.Tech – EMBEDDED SYSTEM DESIGN
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCES101	PC	Advanced Microprocessor	3	3	0	0	3
2	P18PCES102	PE	Embedded Control System Design	3	3	0	0	3
3		PE	Professional Elective – 1	3	3	0	0	3
4		PE	Professional Elective – 2	3	3	0	0	3
5	P18PRES103		Research Methodology and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
7	P18PCES1L1	PC	Embedded System Design Lab	4	0	0	4	2
8	P18PCES1L2	PC	Advanced Microprocessor Lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCES201	PC	Real Time Systems and its Applications	3	3	0	0	3
2	P18PCES202	PC	FPGA Integrated circuit Design	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		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCES2L1	PC	Real Time operating system design lab	4	0	0	4	2
7	P18PCES2L2	PC	VLSI Design Lab	4	0	0	4	2
8	P18PRES2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRAE3P2	PR	Phase – I Dissertation	20	0	0	20	10
Total				26	6	0	20	16

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRAE4P3	PR	Phase-II Dissertation	32	0	0	32	16
Total				32	0	0	32	16

TOTAL CREDIT

18+18+16+16= 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEES011	PE	SDR and cognitive radio	3	3	0	0	3
2	P18PEMA106	PC	Advanced Mathematics for Electronics Engineers	3	3	0	0	3
3	P18PEES013	PE	Hardware and Software Co design	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEES021	PE	Designing of Digital Control Systems	3	3	0	0	3
2	P18PEES022	PE	Artificial Intelligence and Expert Systems	3	3	0	0	3

3	P18PEES023	PE	Foundations of LINUX in Embedded Systems	3	3	0	0	3

PROFESSIONAL ELECTIVE – 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEES031	PE	Image Processing and pattern recognition	3	3	0	0	3
2	P18PEES032	PE	Computational Techniques of Distributed Embedded Systems	3	3	0	0	3
3	P18PEES033	PE	Cyrpto Analaytic System Techniques	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEES041	PE	Computational Techniques in Real Time Operating Systems	3	3	0	0	3
2	P18PEES042	PE	ASIC Design	3	3	0	0	3
3	P18PEES043	PE	Embedded wireless sensor networks	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEES051	PE	Electromagnetic Interference And Compatibility in System Design	3	3	0	0	3
2	P18PEES052	PE	Advanced Wireless Communication	3	3	0	0	3
3	P18PEES053	PE	Introduction To MEMS System Design	3	3	0	0	3

OPEN ELECTIVE

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

Audit I& Audit II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18ACEN001	AC	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	AC	Disaster Management	2	2	0	0	0
3	P18ACEN003	AC	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	AC	Value Education	2	2	0	0	0
5	P18ACLW005	AC	Constitution of India	2	2	0	0	0
6	P18ACBA006	AC	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	AC	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	AC	Personality Development through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

P18PCES101	ADVANCED MICROPROCESSOR	L	T	P	C
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To expose the students to the fundamentals of microprocessor architecture.
To introduce the advanced features in microprocessors.

SYLLABUS:

UNIT – I **9**

Evaluation of 16/32 Bit Processor – 8086 Processor: Architecture – Programming Model – Memory Organization – Interrupt Structure – Instruction Set.

UNIT – II **9**

80X 86 PROCESSOR FAMILIES: 80286 Processor – Functional Block Diagram – Memory Organization – Modes of Operation – Real and Protected Modes – Address Translation Techniques – Virtual Memory.

UNIT – III **9**

80386 Processor : Basic Programming Model – Memory Organization – Data Types Instruction Set, Addressing Modes – Address translation – Interrupts – Assembly Language Programming. 80486 Processor : Architecture and Programming Model – Pentium Processor Architecture.

UNIT – IV **9**

680X0 Processor Family : 68020 Processor : Functional blocks – Programmers model – Data types Organisation – Instruction Set – Exception Processing – Cache Memory – Virtual Memory – Memory Management Unit.

UNIT – V **9**

68030 Processor : Block Diagram – Programming Model – On Chip Memory Management Unit – Read Write Timing Diagram – Addressing Modes Instruction Set. RISC Processor : Features of RISC Processor – Typical RISC Processor Architecture.

Total Periods : 45 Hours

References:

1.Mohammed Rafiquzzman, “Microprocessos and Microcomputer Based System Design”, Universal Book Stall, New Delhi, 1990.
2.Barry B Bery, “The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro – Processor Architecture, Programming and Interfacing”,Prentice Hall of India, 4th Edition, 1997.
3.Intel, “Microprocessors, Vol-I &Vol-II”, Intel Corporation, USA, 1992.

Intel Ciminera and Advance Voltage "Advanced Microprocessor Architecture", Addison Wesley, USA, 1987.

COURSE OUTCOMES (COs)	
CO1	The students will be able to work with suitable microprocessor for a specific real world application.
CO2	To Understand the generalized architecture of advanced microprocessors.
CO3	To develop algorithm/program of the advanced microprocessors for a particular task.
CO4	To Interface advanced microprocessors with external peripherals.
CO5	Students can understand the evaluation of microprocessors.
CO6	Students can understand the evaluation of RISC processors.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
3	Category	Professional Core										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCES102	**EMBEDDED CONTROL SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				

Course Objectives

- To expose the students to the fundamentals of Embedded System Blocks
- To teach the fundamental RTOS.
- To study on interfacing for processor communication
- To compare types and Functionalities in commercial software tools
- To discuss the Applications development using interfacing

SYLLABUS:

UNIT-I INTRODUCTION 9

Controlling the hardware with software – data lines number systems address lines schematic representation hit masking programmable peripheral interlace Switch input detection.

UNIT-II INPUT OUTPUT DEVICES 9

Keyboard basic – keyboard scanning algorithm – multiplexed LED displays – character LCD modules- LCD module display – configuration – time – of- day – clock – timer managerinterrupts – interrupt service routines – IRQ-ISR-interrupt vector or dispatch table multiple point – interrupt – driven pulse width modulation.

UNIT-III D/A AND CONVERSION 9

R-2R ladder – more on op – amps – virtual ground – resister network analysis – port offsets – triangle waves analog Vs digital values –ADC0809- comparator – successive approximation – the ADC clock – ripple counter – D flip flop –Q and NOTQ- capturing analog information in the timer interrupt service routine – automatic, multiple channel analog to digital data acquisition.

UNIT-IV ASYNCHRONOUS SERIAL COMMUNICATION 9

Asynchronous serial communication – RS – 232 -RS – 485 – sending and receiving data _ serial ports on PC –low level PC serial I/O module – buffered serial I/O.

UNIT-V CASE STUDIES 9

Multiple closure problems – basic outputs with PPI – controlling motors – bidirectional control of motors – H bridge – telephonic systems – burglar alarms – fire alarms – inventory control systems.

Total Periods: 45 Hours

TEXT BOOKS:

1. Jean J. labrosse,'' embedded systems building blocks:complete and ready_to_usemoduyles in C,''the publisher, paultemme, 1999,
2. Ball S.R, embedded microprocessor systems_real world design, prentice hall,1996.

REFERENCES BOOKS:

1.HermaK,"real time systems_design for distributed embedded applications '' kulweracademic , 1997.

2.Daniel W.lewis," fundamental of embedded software where C and assembly meet'' PHI 2002.

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Explain various embedded system applications and design requirements
CO2	Construct embedded system hardware
CO3	Develop software programs to control embedded system
CO4	Generate product specification for embedded system
CO5	Outline validation and testing methodologies for embedded system
CO6	multiple channel analog to digital data acquisition.

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	H	M	H			H	H	M	M
	CO2	M	H	M	H	M			H	H	H	H
	CO3	M	H	H	H	H			H	M	H	H

	CO4	H	M	H	M	H			M	H	M	H
	CO5	H	M	H	M	H			H	H	M	H
	CO6	H	H	M	H	H			H	M	H	H
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PRES103	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	2	0	0	2
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

Student will understand research problem formulation and Analyze research related information

SYLLABUS

Unit 1: LITERATURE SURVEY

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: DATA ANALYSIS AND INTERPRETATION

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: REPORT WRITING

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: NATURE OF INTELLECTUAL PROPERTY

Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications, Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT & REFERENCE BOOKS:

1.Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To understand the Approaches of investigation of solutions for research problem
CO2	Students to analysis Plagiarism
CO3	To able to understand the Effective technical writing
CO4	Nature of Intellectual Property
CO5	Understand the concept of Patent Rights
CO6	To gain knowledge in New Developments in IPR

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L 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	M	H	H		H						H
	CO2	M	H	H		H						L
	CO3	M				M			H			L
	CO4	M	H	L		H			M			H
	CO5	M		M		M			L			
	CO6	M				L			H	M		
3	Category	PROFESSIONAL CORE COURSES (PCC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCES1L1	**EMBEDDED SYSTEM DESIGN LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**0**	**0**	**4**	**2**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineerir				

Course objectives:

- Understand the problem to be solved by incorporating PIC microcontroller.
- Identify the appropriate interfacing device for the problem.
- Design and execution of interfacing circuits.
- Practice simple programming in PIC.
- Experiment with peripheral devices on the PIC evaluation kit.

LIST OF EXPERIMENTS

1. ADC Interface Experiment with Temperature Sensor.

2. Stepper Motor Interface.
3. Traffic Light Controller.
4. DAC/DC Motor Speed Control.
5. PIC to PC Serial (Rs232) Communication.
6. 5 X 7 Matrix Led Display Interface and 16 X 2 Character LCD Interface.
7. 4x4 Hex Board Interface.
8. Programmable Logic Control

COURSE OUTCOMES (COs)	
CO1	Students will learn about the interfacing concepts and implement it by using PIC microcontroller
CO2	Practice simple programming in ARM.
CO3	Employ and test thumb and special instructions ARM in programs.
CO4	Develop algorithms and code for I/O with ARM.
CO5	Experiment with peripheral devices on the ARM evaluation kit
CO6	Students will learn about the programmable Logic Control

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	M	H	M	M			M	M		M
	CO2	M	M	H	M	H			M	H	M	
	CO3	H	M	M	H	M			H		M	H
	CO4	H	H	M	H	M			M	H	H	M
	CO5	M	H	H	H	H				M		H
	CO6	M	H	H	H	H			M	M	M	M
3	Category	Professional Core(PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCES1L2	**ADVANCED MICROPROCESSOR LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To become familiar with the architecture and Instruction set of Intel 8085 microprocessor. ... To familiarize the students with interfacing of various peripheral devices with 8085 microprocessor.

LIST OF EXPERIMENTS

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C p

COURSE OUTCOMES (COs)	
CO1	To understand basic architecture of 16 bit and 32 bit micro processors.
CO2	To understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design.
CO3	To understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.
CO4	To understand RISC and CISC based microprocessors.
CO5	To understand concept of multi core processors.
CO6	Understand and devise techniques for faster execution of instructions, improve speed of operations and enhance performance of microprocessors.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H	M	H			M	M	L	H
	CO2	M	H	H	M	M			L	M	L	M
	CO3	M	H	H	M	M			L	M	L	M
	CO4	M	M	H	H	M			L	M	L	M

	CO5	M	H	M	H	M			M	H	M	H
	CO6	H	M	M	M	M			L	M	L	M
3	Category	Professional Core										
4	Approval	47th Meeting of Academic Council, Aug 2018										

SEMESTER II

		L	T	P	C
P18PCES201	**REAL TIME SYSTEMS AND ITS APPLICATIONS**				
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics And Communication Engineering				

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

SYLLABUS:

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.

TOTAL PERIODS: 45 HOURS

TEXTBOOKS

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, 2017

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	Describe analyze real-time systems designs
CO4	To teach the different algorithms and techniques used for real time systems
CO5	Develop design a real-time system (at least partially)
CO6	Define the and assess the relevant literature and research trends of real-time systems

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											
	CO2	L			H	M			L	M		L
	CO3		H									
	CO4										L	
	CO5	H		M	L							
	CO6											
3	Category		Professional core(PC)									
4	Approval		47th Meeting of Academic Council, Aug 2018									

SYLLABUS:

P18PCES202	FPGA INTEGRATED CIRCUIT DESIGN	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

FPGA(Field Programmable Gate Array) is known as an integrated circuit in the form of semi-custom. Du the improvement of the technological level of semiconductors, FPGA has been widely spread in the are digital circuit design. Also, the FPGA integrated circuit is being developed based on some programma device such as PAL and GAL.

UNIT – I Evolution of programmable devices **9**

Introduction to AND-OR structured Programmable Logic Devices PROM, PLA, PAL and MPGAs; Combinational and sequential circuit realization using PROM based Programmable Logic Element (PLE); Architecture of FPAD, FPLA, FPLS and FPID devices.

UNIT –II FPGA Technology **9**

FPGA resources - Logic Blocks and Interconnection Resources; Economics and applications of FPGAs; Implementation Process for FPGAs Programming Technologies - Static RAM Programming, Anti Fuse Programming, EPROM and EEPROM Programming Technology; Commercially available FPGAs - Xilinx FPGAs, Altera FPGAs; FPGA Design Flow Example - Initial Design Entry, Translation to XNF Format, Partitioning, Place and Route, Performance Calculation and Design Verification.

UNIT – III Technology Mapping for FPGAs **9**

Logic Synthesis - Logic Optimization and Technology Mapping;Lookup Table Technology Mapping - Chortle-crf Technology Mapper, Chortle-d Technology Mapper, Lookup Table Technology Mapping in mis-pga, Lookup Table Technology Mapping in Asyl and Hydra Technology Mapper; Multiplexer Technology Mapping - Multiplexer Technology Mapping in mis-pga.

UNIT – IV Routing for FPGAs **9**

Routing Terminology; Strategy for routing in FPGAs; Routing for Row- Logic Block Architecture: Logic Block Functionality versus Area-Efficiency - Logic Block Selection, Experimental Procedure, Logic Block Area and Routing Model and Results. Based FPGAs - Segmented channel routing, 1-channel routing algorithm, K – channel routing algorithm and results.

UNIT –V COMPUTATIONAL ARCHITECTURES FOR FPGA **9**

Distributed arithmetic for FPGA – CORDIC architectures for FPGA- Boolean satisfiability – SAT solvers

TEXT BOOKS:

1. S.Brown, R.Francis, J.Rose, Z.Vransic, “Field Programmable Gate Array”, Kluwer Publication, 1992.

2. Rahul Dubey, “Introduction to Embedded System Design Using Field Programmable Gate Arrays”, Springer, 2009.

3. Uwe Meyer-Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer Series, 3rd Edition, 2007.

REFERENCE BOOKS:

1. S.Trimberger, Edr., "Field Programmable Gate Array Technology", Kluwer Academic Publications, 1994

COURSE OUTCOMES (COs)												
CO1	Demonstrate in-depth knowledge in FPGAs Design & Architecture and Motor Control with FPGAs.											
CO2	Analyze complex engineering problems critically in Programmable digital systems.											
CO3	Develop skills to solve the problems in placement and routing of FPGAs.											
CO4	Apply appropriate techniques to engineering problems in the design of FPGAs.											
CO5	FIR and IIR Digital Filter implementation with FPGAs											
CO6	FPGA Fabric Immersed Processors											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L 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	M	M	L	M
	CO2	M	H	H	M	M		L	M	M	M	M
	CO3	H	H	H	M	H		L	M	M	M	M
	CO4	M	H	H	M	H		L	M	M	M	M
	CO5	H	H	H	H	M		M	M	M	M	L
	CO6	M	H	M	M	M		L	M	L	M	M
3	Category	Professional core(PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCES2L1	**REAL TIME OPERATING SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES:

- To learn about the design of digital circuits using Hardware description languages
- To learn about the design of FPGA based design methodology.
- To study about the design of simulation of analog building blocks.
- To understand about digital CAD design flow.
- To know about SPICE simulation

LIST OF EXPERIMENTS:

A. Vx WORKS – RTOS LAB

1. Thread Management.
2. Pipes, Message Queue & Semaphore.
3. Ram Disk And File System.
4. Memory Management & Watching Timer.
5. VHDL LAB
6. Design of Basic Gates, Adders & Subtractors.
7. Design of Mux, Demux, Encoder, Decoder & Synchronous Counter.
8. Design of Parallel Adder, Comparator, Flip- Flops, Shift Register & Ram
9. Design of A/D Converter Using FGFA Kit

COURSE OUTCOMES (Cos)	
CO1	Design and test digital logic circuits on FPGA.
CO2	Design Electronic circuits using SPICE and PCB layout using EDA tools
CO3	To design and Test of multiplexers and coders
CO4	To design and Test of flip flops
CO5	To design and Test of counters and registers

CO6	To design and Test of A/D Convertors											
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L 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	H			H	M	M	H
	CO2	M	H	H	H	H			H	M	L	H
	CO3	L	H	L	H	L			H	M	M	H
	CO4	L	H	M	M	L			H	M	M	H
	CO5	M	H	H	L	H			H	M	L	H
	CO6	L	H	H	M	M			M	L	M	M
3	Category	Professional core(PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCES2L2	**VLSI DESIGN LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Logic system design and verification				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES: Physical design of CMOS logic can be known and SPICE simulation of analog circuits wii be carried out to measure its related parameters.					

LIST OF EXPERIMENTS:

1. Introduction to layout design rules
   Layout, physical verification, placement & route and static timing analysis for the following:
2. CMOS inverter
3. CMOS NOR/ NAND gates
4. CMOS XOR and MUX gates
5. CMOS half adder and full adder
6. Static / Dynamic logic circuits (register cell)
7. Latch
8. Pass transistor
9. Layout of any combinational circuit (complex CMOS logic gate)- Learning about data paths
10. Introduction to SPICE simulation and coding of NMOS/CMOS circuit
11. SPICE simulation of basic analog circuits: Inverter / Differential amplifier
12. Analog Circuit simulation (AC analysis) – CS & CD amplifier
13. System level design using PLL

COURSE OUTCOMES (Cos)	
CO1	To understand about layout in VLSI design
CO2	To understand about SPICE simulation of basic analog circuits.
CO3	To understand about placement and routing in VLSI design
CO4	To understand about SPICE simulation of basic Digital circuits.
CO5	To understand about CMOS technology in VLSI design
CO6	To understand about PLL 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
2	CO1	L	H	M	M	M			H	M	L	H
	CO2	M	H	M	M	M			H	M	M	H
	CO3	L	H	M	M	M			H	M	L	H
	CO4	M	H	M	M	M			H	M	L	M
	CO5	L	H	H	M	M			H	M	M	H
	CO6	L	H	H	M	M			H	M	L	H
3	Category	Professional core(PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE - 1					
P18PEES011	**SDR AND COGNITIVE RADIO**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- Learn the design of the wireless networks based on the cognitive radios
- Understand the concepts of wireless networks and next generation networks.

.

SYLLABUS:

UNITI 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 Architechture.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Total : 45 Periods

TEXT BOOKS

1. Joseph Mitola III,"Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication",ARTECH HOUSE .2009.
1. 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, May 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", John Wiley, 2003.
4. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010
1. 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 networks 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 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	L	M	L	M			H	M	H	L
	CO2	M	M	M	M	M			M	M	M	L
	CO3	M	H	H	M	H			L	L	L	H
	CO4	M	H	H	L	H			M	L	M	M
	CO5	M	M	M	H	H			M	M	M	M
	CO6	H	M	H	M	H			L	M	M	M
3	Category		Professional Electives(PE)									
4	Approval		47th Meeting of Academic Council, Aug 2018									

P18PEMA106	**ADVANCED MATHEMATICS FOR ELECTRONICS ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept of Mathematics				

OBJECTIVES

To apply all taught techniques to unseen problems, and queuing is a major branch of optimization, Random variable compute and interpret means, correlation/covariance, PERT and CPM chart is mainly used for documenting the data(visually) on projects.

SYLLABUS

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 9

Random variables and their functions - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Exponential, Gamma, Weibull and Normal distributions.

UNIT II MATRIX THEORY 9

Eigen values using QR Transformations generalized eigenvectors – Canonical forms, singular valued composition and application – matrix norms and induced norms Psuedo inverse – least square approximations

UNIT III SPECIAL FUNCTIONS 9

Bessel's Equation- Bessel Functions- Legendre's Equation- Legendre Polynomials- Rodrigue's Formula- Recurrence Relations- Generating Functions and Orthogonal Property for Bessel Function of the First Kind.

UNIT IV OPERATIONS RESEARCH 9

Network Definitions – Minimal Spanning Tree algorithm – Shortest Route Problem – Maximal Flow model – Minimum Cost Capacitated Flow Problem – CPM and PERT.

UNIT V QUEUING THEORY 9

Single and Multiple Server Markovain Queuing Models – Customer Impatience Priority Queues M/g / I Queuing System –Queuing Applications.

TEXT BOOKS:

1. Handy A.Taha., "Operations Research An Introduction", 7th Edn. Pearson Education , Chennai-113. 2002.
2. Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 2nd Edn.
3. Wiley India Pvt Ltd, New Delhi.

R**EFERENCE BOOKS:**

1. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi. 1994.
2. Gupta.SC and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.
3. Stewart G.W. "Introduction to Matrix Computaions" Academic Press, New York.

COURSE OUTCOMES (COs)	
CO1	The student will learn to analyze and solve the fundamental problems with prescribed conditions in simple cases.
CO2	The student will learn to understand how signals, systems, inference combine in prototypical tasks of communication.
CO3	The student will learn to manipulate matrices and to do matrix algebra, determinants, Eigen values Eigen vectors and to solve the system of linear equations.
CO4	The student will learn to understand how signals, systems, control.
CO5	The student will learn to understand how signals, systems, signal processing.
CO6	The student will learn operation research methodology.

Mapping of Course Outcomes with Student Outcomes (SOs) (S/M/L 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	H			H	H	L	H
	CO2	H	H	M	H	H			H	H	M	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M	L	M	M			L	M	L	M
	CO5	H	H	M	H	M			M	M	M	L
	CO6	H	M	M	H	H			H	M	M	L
3	Category	PE										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEES013	HARDWARE AND SOFTWARE CO-DESIGN	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To acquire the knowledge about system specification and modeling.
- To learn the formulation of partitioning
- To analyze about co-synthesis.
- To study the different technical aspects about prototyping and emulation.
- To formulate the design specification and validate its functionality by simulation

SYLLABUS

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modelling , Co-Design for Heterogeneous Implementation – Processor Synthesis Single-Processor Architectures with one ASIC, Single-Processor Architectures with many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation ,Requirements for Embedded System Specification.

UNIT II HARDWARE/SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem , Optimization , HW /SW Partitioning based on Heuristic Scheduling, HW /SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments,Future Developments in Emulation and Prototyping ,Target Architecture-Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL:45 PERIODS

TEXT & REFERENCES :

1. Ralf Niemann , "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne W olf ,"Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub,1997.
3. Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design" Kaufmann Publishers,2001.

COURSE OUTCOMES (COs)	
CO1	Designing and modeling of Single-Processor Architectures
CO2	To analyze hardware and software partitioning
CO3	To analyze hardware and software co-synthesize
CO4	To study about Prototyping and Emulation Techniques
CO5	Designing and Representation for System Level Synthesis
CO6	Design specifications and validate its functionality by simulation

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	M	H	M	L			L	L	L	M
	CO2	L	L	L	M	M			M	L	L	L
	CO3	H	L	H	M	M			M	L	L	L
	CO4	L	L	L	M	M			M	L	L	L

	CO5	H	M	H	M	L			L	L	L	M
	CO6	H	M	H	M	L			L	L	L	M
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

PROFESSIONAL ELECTIVE -2					
P18PEES021	**DESIGNING OF DIGITAL CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite –NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:
To provide sound knowledge on the principles of discrete data control system

SYLLABUS:

UNIT I COMPUTER CONTROLLED SYSTEM 9

Configuration of the basic digital control scheme – general sampled data system variables – signal classifications – why use digital control system – Advantages – disadvantages – examples of discrete data and digital control systems.

UNIT II SIGNAL PROCESSING IN DIGITAL CONTROL 9

Sampling process – frequency domain analysis – ideal samples – Shanon!s sampling theorem – generation and solution of process – linear difference equations – data reconstruction process – frequency domain characteristics.

UNIT III DISCRETE SYSTEM MODELLING 9

Determination of the Z transform – mapping between s and Z domains $transform of system equations – open loop hybrid sampled data Control Systems – open loop discrete input data Control System – closed loop sampled data control system – modified Z transform method – response between sampling instants – stability on the Z plane and jury!s stability test – steadystate error analysis for stable systems.

UNIT IV STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS 9

State descriptions of digital processors – conversion of state variable models to transfer functions – conversion of transfer functions to canonical state variable models – first comparison form – second

companion form –jordon Canonical form – state description of sampled continuous time plants – solution of state difference equations – closed form solution – state transition matrix – Caley camilton Technique – concept of controllability and absorbability – loss of control abilityand absorbability due to sampling.

UNIT V DESIGN OF DIGITAL CONTROL 9

Digital P,PI,PID Controller – Position and velocity forms – state regulator design – design of state observers – dead beat control by state feed back and dead beat observers.

TOTAL : 45 PERIODS

TEXT BOOKS

1.C.M.Houpis,G.B.LAMOUNT,'Digital control systems-Theory,hardware,software',international student edition,McGraw Hill book co,1985.
2.M.Gopal,'Digital control and state variables methods'Tata Mcgraw Hill,2nd Edition,2003

REFERENCES

1.B.C.Kuo,"Digital control systems" second edition,oxford university press,1992
2.P.B.Deshpande and R.H.Ash,'computer process control",ISA Publication USA,1995.

COURSE OUTCOMES (COs)	
CO1	To study the importance of sample data control system.
CO2	To give adequate knowledge about signal processing in digital control
CO3	To study the importance of modeling of discrete systems.
CO4	To study the importance of state space representation for discrete data system
CO5	To introduce the design concept for digital controllers
CO6	To study the stability analysis of discrete data system

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	L	L	L	H	H			H	M	M	M
	CO2	H	M	H	M	M			M	L	L	M
	CO3	H	M	H	M	M			L	L	M	L
	CO4	H	M	H	M	H			M	M	L	H
	CO5	H	M	H	M	M			L	L	M	L
	CO6	H	M	H	M	H			M	M	L	H
3	Category	Professional Electives(PE)										

4	Approval	47th Meeting of Academic Council, Aug 2018

P18PEES022	**ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

- To study the idea of intelligent agents and search methods.
- To study about representing knowledge.
- To study the reasoning and decision making in uncertain world.
- To construct plans and methods for generating knowledge.
- To study the concepts of expert systems

SYLLABUS:

UNIT-I INTRODUCTION TO ARRTIFICIAL INTELLIGENCE 9

Introduction to AI: Intelligent agents – Perception –Natural language processing – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.

UNIT-II KNOWLEDGE AND REASONING 9

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT-III UNCERTAIN KNOWLEDGE AND REASONING 9

Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.

UNIT-IV PLANNING AND LEARNING 9

Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.

UNIT-V EXPERT SYSTEMS 9

Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.

Total periods: 45 Hours

TEXT BOOKS

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education 2003/PHI
2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.

REFERENCES

1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving',Fourth Edition,Pearson Education 2002
2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.
3. Janakiraman, K.Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.
4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.

COURSE OUTCOMES (COs)	
CO1	Understand the Concepts of Artificial Intelligence and Expert System Concepts. Examine methods that have emerged from both fields
CO2	Explain the various current mirror circuits and analyze differential amplifier with active load.
CO3	Analyze and design a fuzzy logic system using fuzzy logic tool box.
CO4	Analyze and design a neural network system using neural network toolbox.
CO5	Analyze and design a rule-based expert system.
CO6	Understand about knowledge acquisition

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

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	M	H	H	H			H	H	H	H
	CO2	H	H	M		M						
	CO3	H	H	H	H	H			H	H	H	H
	CO4	H	H	H	H	H			H	H	H	H
	CO5	M	H		M					M		
	CO6	M	H			M				M		M

Category		Professional Elective(PE)
4	Approval	47th Meeting of Academic Council, Aug 2018

P18PEES023	**FOUNDATIONS OF LINUX IN EMBEDDED**	**L**	**T**	**P**	**C**

	SYSTEMS				
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Real time systems and its applications				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- This is a course to explore in Embedded Systems hardware and firmware in LINUX.
- The course uses a bottom-up approach in gradually building and optimizing Embedded System Software.
- This course introduces basic RTOS principles and Embedded Software Development process.

SYLLABUS:

UNIT I - LINUX FUNDAMENTALS **9**

Introduction - host-target development setup - hardware support - development languages and tools – RT linux.

UNIT II - INITIALIZATION **9**

Linux kernel and kernel initialization - system initialization – hardware support - bootloaders.

UNIT III - DEVICE HANDLING **9**

Device driver basics - module utilities - file systems - MTD subsystems – busy box.

UNIT IV - DEVELOPMENT TOOLS **9**

Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux - Linux and real time - SDRAM interface.

UNIT V - DEVICE APPLICATIONS **9**

Asynchronous serial communication interface - parallel port interfacing - USB interfacing - memory I/O interfacing - using interrupts for timing.

TEXT BOOKS & REFERENCES

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.

3. Craig Hollabaugh, “Embedded Linux: Hardware, software and Interfacing”, Pearson Education, 2002.

4. Doug Abbott, “Linux for embedded and real time applications”, Elsevier Science, 2003.

COURSE OUTCOMES (COs)	
CO1	To enable the student to learn developing Linux based embedded applications

CO2	To learn fundamentals of embedded linux
CO3	To learn to use GNU tool chain.

PROFESSIONAL ELECTIVE - 3					
P18PEES031	**IMAGE PROCESSING AND PATTERN RECOGNITION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				
OBJECTIVES					

CO4	To learn to implement embedded linux applications.
CO5	To explain programming concepts and embedded programming in C and assembly language
CO6	To explain real time operating systems, inter task communication and an embedded software development tool

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H	L	H	H	M			M	H	M	H
	CO2	L	L	M	H	H			H	M	H	H
	CO3	M	L	H	M	L			M	L	L	M
	CO4	H	L	H	H	H			H	M	H	H
	CO5	L	L	H	H	M			H	H	M	H
	CO6	L	L	H	H	M			H	H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

This course emphasizes general principles of image processing. Topics such as image enhancem image restoration, image segmentation and image compression are covered. Some concepts of pat recognition are also introduced in this course.

SYLLABUS:

UNIT –I FUNDAMENTALS OF DIGITAL IMAGE FORMATION 9

Elements of Visual perception – A simple Image Model – Sampling and Quantization – Some Basic

COURSE OUTCOMES (COs)

Relationship between Pixels.

UNIT-II IMAGE TRANSFORMS 9

Two Dimensional Orthogonal and Unitary Transforms – Properties of Unitary Transforms – One Dimensional DFT – Two Dimensional DFT – Cosine Transforms – Sine transforms – Hadamard Transforms – Haar Transforms – Slant transforms.

UNIT-III IMAGE ENHANCEMENT 9

Point Operations – Histogram Modeling – Spatial Operations – Transform Operations. Gray level transformation techniques- Spatial domain techniques - Half toning, Median filtering, contrast stretching, Histogram Equalization-

UNIT-IV IMAGE RESTORATION AND COMPRESSION 9

Image observation models – Inverse and Wiener Filtering – Pixel Coding – Predictive techniques – Transform Coding of Images. Source coding techniques - Run length coding - Shannon-Fano coding- Huffman coding- Arithmetic coding- LZW coding - Transform and Predictive compression methods - Vector quantization- case studies - JPEG-MPEG.

UNIT-V INTRODUCTION TO PATTERN RECOGNITION 9

Elements of Image Analysis, Introduction to pattern classification Feature selection and extraction, Supervised and Unsupervised Parameter estimation Basic concepts- Structure of a typical pattern recognition system Feature vectors , Feature spaces , Pattern classification by distance functions - Minimum distance classification – Cluster algorithms

TOTAL: 45 PERIODS

TEXT & REFERNCES:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Reprint, 2008. R. O. Duda, P. E. Hart, D. G. Stork, Pattern Classification, 2nd edition, John Wiley & Sons, Inc., 2000.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall of India, New Delhi, 2001.
3. Image processing, Analysis, and Machine vision by Milan Sonka, Vaclav Hlavac Roger Boyle, Vikas Publishing House.
4. S. Theodoridis, K. Koutroumbas, Pattern Recognition, 4th edition, Academic Press, 2009

CO1	To introduce students the fundamentals of image formation.
CO2	Identify and describe operation of different smoothing and sharpening filters.
CO3	Students are able to analyze the different segmentation techniques
CO4	Students are able to apply different de-noising models to recover original image.
CO5	To develop an appreciation for various issues in the design of computer vision and object recognition systems.
CO6	To provide the student with programming experience from implementing computer vision and object recognition applications.

P18PEE032	**COMPUTATIONAL TECHNIQUES OF DISTRIBUTED EMBEDDED SYSTEMS**							**L**	**T**	**P**	**C**
Total Contact Hours: 45								3	0	0	3

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

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k
	CO1	M	L	L	H	H		L	H	H	M	H
	CO2	M	L	H	H	H		L	H	H	M	H
	CO3	M	L	L	H	H		L	H	H	M	H
	CO4	M	L	L	H	H		L	H	H	M	H
	CO5	M	H	H	H	H		L	H	H	M	H
	CO6	M	M	H	H	H		L	H	H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

	Prerequisite: NIL
	Course Designed by : Dept. of Electronics And Communication Engineering

OBJECTIVES

1.To expose the students to the fundamentals of Network communication technologies.
2.To teach the fundamentals of Internet
3.To study on Java based Networking
4.To introduce network routing Agents
5.To study the basis for network on-chip technologies.

SYLLABUS:

UNIT I THE HARDWARE INFRASTRUCTURE 9

Broad Band Transmission facilities – Open Interconnection standards – Local Area Networks – Wide Area Networks – Network management – Network Security – Cluster computers.

UNIT II INTERNET CONCEPTS 9

Capabilities and limitations of the internet – Interfacing Internet server applications to corporate databases HTML and XML Web page design and the use of active components.

UNIT III EMBEDDED AGENT 9

Introduction to the embedded agents – Embedded agent design criteria – Behavior based, Functionality based embedded agents – Agent co-ordination mechanisms and benchmarks embedded-agent. Case study: Mobile robots.

UNIT IV EMBEDDED COMPUTING ARCHITECTURE 9

Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

UNIT V WEB BASED HOME AUTOMATION 9

Components of Distributed Embedded - Protocols & Standards - Hardware/Software selection for Distributed Embedded – case study : Web based Home Automation

TOTAL: 45 PERIODS

TEXT BOOKS & REFERENCES:

1. Dietel & Dietel, “JAVA how to program”, Prentice Hall 1999.
2. 2. Sape Mullender, “Distributed Systems”, Addison-Wesley, 1993.
3. 3. George Coulouris and Jean Dollimore, “Distributed Systems – concepts and design”,Addison –Wesley 1988.

SYLLABUS:

UNIT-I SECURITY PROBLEM 9

Security problem in computing – characteristics of computers in intrusion – kinds of security preaches – points of security vulnerability – methods of defense – controls – effectiveness of controls – plan of attack encryption

P18PEES033	**CYRPTO ANALAYTIC SYSTEM TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

The aim of the course is to know about various encryption techniques, understand the concept of Public key cryptography, message authentication and hash functions, impart knowledge on Network security and to learn the basic concepts of system level security

UNIT-II CRYPTOGRAPHY 9

Basic encryption and decryption – mono alphabetic ciphers – poly alphabetic submission – transpositions – fractional Morse – stream and block ciphers-characteristics of good ciphers – secure encryption systems – public key system – single key system – data encryption standard – rivets – Shamir – Adelman (RSA) encryption

UNIT-III ROLE OF OPERATING SYSTEM 9

Security involving programs and operating system – information access problems – program development controls – operating system controls – operating system controls in use of programs administration controls – protection services for users of operating system – protected objects and method of protection – file protection mechanism – user authentication.

UNIT-IV DATABASE AND NETWORK SECURIY 9

Databases and network security – security requirements for data base – reliability and integrity – sensitive data – interference problem – multilevel data bases – network security issues – encryption in networking – access control – user authentication – local area networks – multi level security of network.

UNIT-V COMMUNICATION AND SYSTEM SECURITY 9

Communication and system security – communication characteristics – communications media – loos of integrity – wire tapping – electronic mail security IP security – WEB security – intruders – viruses – worms firewalls – standards.

Total Periods: 45 Hours

Textbooks

1. William stallings cryptography and network security principles and practice, PHI 1998
2. Charles, P. pleeger, security in computing, PHI, 1998

Reference Books

1. Hans, information and communiocation security, springer verlag, 1998
2. Simonds, network security, MCGrawhill, 1998
3. Derek atkins, internet security, techmedia, 1998
4. Kernel texplan, communication network management, PHI,1992.

COURSE OUTCOMES (COs)	
CO1	Classify the symmetric encryption techniques.
CO2	Illustrate various Public key cryptographic techniques.
CO3	Evaluate the authentication and hash algorithms.
CO4	Discuss authentication applications
CO5	Summarize the intrusion detection and its solutions to overcome the attacks.
CO6	Students will be able to learn about the basic concepts of system level security.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	L	L	H	H		L	H	H	M	H
	CO2	M	L	L	H	H		L	H	H	M	H
	CO3	H	L	M	H	H		L	H	H	M	H
	CO4	M	M	H	H	H		L	H	H	M	H
	CO5	M	L	H	H	H		L	H	H	M	H
	CO6	M	L	L	H	H		L	H	H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

PROFESSIONAL ELECTIVE - 4					
P18PEES041	**COMPUTATIONAL TECHNIQUES IN REAL TIME OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: NIL				

	Course Designed by : Dept. of Electronics And Communication Engineering

OBJECTIVES

To design the single stage amplifiers using pmos and nmos driver circuits with different loads and To analyze high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers

SYLLABUS:

UNIT I REVIEW OF OPERATING SYSTEMS 9

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed Scheduling-Fault &recovery.

UNIT II OVERVIEW OF RTOS 9

RTOS Task and Task state –Multithreaded Premptive scheduler- Process SynchronisationMessage queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks

UNIT III REAL TIME MODELS AND LANGUAGES 9

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REAL TIME KERNEL 9

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V RTOS APPLICATION DOMAINS 9

Case studies-RTOS for Image Processing – Embedded RTOS for Network communication – RTOS for fault-Tolerant Applications – RTOS for Control Systems.

TOTAL : 45 PERIODS

TEXT BOOKS & REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed,John Wiley,2003
2. D.M.Dhamdhere," Operating Systems,A Concept-Based Approch,TMH,2008
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
4. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
5. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill 1997.
6. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
7. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI 1999.
8. Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill 2000.

COURSE OUTCOMES (COs)	
CO1	To expose the students to the fundamentals of interaction of OS with a computer and User computation.
CO2	To teach the fundamental concepts of how process are created and controlled with OS.
CO3	To study on programming logic of modeling Process based on range of OS features
CO4	To compare types and Functionalities in commercial OS
CO5	To discuss the application development using RTOS
CO6	An ability to design and conduct experiments as well as to analyze and interpret data

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	L	L	H	H		L	H	H	M	H
	CO2	M	L	L	H	H		L	H	H	M	M
	CO3	M	M	H	H	H		L	H	H	M	H
	CO4	M	L	L	H	H		L	H	H	M	H
	CO5	M	M	H	H	H		L	H	H	M	H
	CO6	M	L	L	H	H		L	H	H	M	L
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEES042	ASIC DESIGN	L	T	P	C
	Total Contact Hours –45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To learn the fundamentals of ASIC and its design methods

SYLLABUS:

UNIT – I INTRODUCTION TO ASIC, CMOS LOGIC AND ASIC LIBRARY DESIGN **9**

Capacitance – Logical Effort – Library Cell Design – Library Architecture Types of ASIC **–** Design Flow – CMOS Transistors – CMOS Design Rules – Combinational Logic Cell – Sequential Logic Cell – Data Path Logic Cell – Transistors as Resistors – Transistor Parasitic**.**

UNIT –II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS. **9**

Anti fuse – Static RAM – EPROM and EEPROM Technology – PREP Bench Marks – Acted ACT – Xilinx LCA – Altars FLEX – Alters MAX – DC & AC Input and Output – Clock and Power Input – Xilinx I/O Blocks.

UNIT – III PROGRAMMABLE ASICS INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY. **9**

Acted ACT - Xilinx LCA - Xilinx EPLD - Alters MAX 5000 & 7000 - Alters MAX 9000 - Alters FLEX – Design System – Logic Synthesis – Half Gate ASIC – Schematic Entry – Low Level Design Language – PLA Tools – EDIF – CFI Design Representation**.**

UNIT – IV LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Verilog and Logic Synthesis– VHDL and LOGIC Synthesis– Types of Simulation – Boundary Scan Test– Fault Simulation- Automatic Test Pattern Generation.

UNIT–V ASICS CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING. **9**

System Partition – FPGA Partitioning – Partitioning Methods – Floor Planning – Placement – Physical Design Flow – Global Routing – Detailed Routing – Special Routing –Circuit Extraction – DRC.

TEXT BOOK:

1. M. J. S. Smith, "Application Specific Integrated Circuits" , Addison – Wesley L Ongnam Inc., 1997.

REFERENCE BOOK:

1. Andrew Brown, "VLSI Circuits and Systems in Silicon", McGraw Hill 1991.
2. S. D. Brown, R. J. Francis, J. ROX, Z. G. Urines, "Field Programmable Publishers, 1992.
3. Mohammed Ismail and Terri Fief, "Analog VLSI and Modern Signal Processing," McGraw Hill 1994.
4. S. Y. Kang, H. J. While Hours, T. Kailath, "VLSI Modern Signal Processing," Prentice Hall, 1985. Jose E. France, Yantis Tsividis, "Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge about CMOS design rules and ASIC cell libraries
CO2	To gain knowledge on programmable architectures for ASICs
CO3	To gain knowledge on programmable interconnect for ASICs
CO4	To understand about logic synthesis
CO5	To understand about testing methods
CO6	To understand the Asics Construction, Floor Planning, Placement And Routing

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L 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	M	H	H		M				M		M
	CO2	M	H	H		M			H	H	H	H
	CO3	M		M		M			M		M	
	CO4	H	H		H					H		H
	CO5	H	H		H				M	M		
	CO6	M	H	H	H	H			H	H	H	H
	Category	Professional Elective(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEES043	EMBEDDED WIRELESS SENSOR NETWORKS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

Wireless sensor network is becoming an important application of embedded systems, giving scope for unique designs and applications. This course is aimed at imparting knowledge on wireless sensor networks and practical implementation

SYLLABUS:

UNIT I - INTRODUCTION TO WSN **9**

Introduction to WSN-Challenges for WSNs - Characteristic requirements - Required mechanisms - Single-node architecture -Hardware components-Energy consumption of sensor nodes-Operating systems and execution environments-Some examples of sensor nodes.

UNIT II - NETWORK ARCHITECTURE **9**

Sensor network scenarios- Optimization goals and figures of merit- Design principles for WSNs, Service interfaces of WSNs- Gateway concepts.

UNIT III - SENSOR NETWORK IMPLEMENTATION **9**

Sensor Programming- Introduction to TinyOS Programming and fundamentals of Programming sensors using nesC- Algorithms for WSN – Techniques for Protocol Programming.

UNIT IV - PROGRAMMING MODELS **9**

An Introduction to the Concept of Cooperating Objects and Sensor Networks- System Architectures and Programming Models.

UNIT V - CASE STUDIES **9**

Wireless sensor networks for environmental monitoring-Wireless sensor networks with mobile nodes-Autonomous robotic teams for surveillance and monitoring-Inter-vehicle communication networks.

Total Periods: 45 Hours

TEXTBOOKS & REFERENCES

1. Holger karl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, John Wiley,2005.

2. Liljana Gavrilovska, Srdjan Krco, Veljko Milutinovic , Ivan Stojmenovic,Roman Trobec, “Application and Multidisciplinary Aspects of Wireless Sensor Networks”, Springer-Verlag, London Limited 2011.

3. Michel Banâtre, Pedro José Marrón, Anibal Ollero, Adam Wolisz, ”Cooperating Embedded Systems and Wireless Sensor Networks “, John Wiley & Sons, Inc .2008.

4. Seetharaman Iyengar, Nandhan, "Fundamentals of Sensor Network Programming Applications and Technology" , John Wiley & Sons, Inc.2008.

COURSE OUTCOMES (COs)	
CO1	Understand the concepts of sensor network
CO2	Understand the implementation issues and techniques of wireless sensor nodes.
CO3	Understand the architecture of Wireless sensor networks
CO4	Explore new programming for WSN like Tiny OS and nesC
CO5	Understand programming models for WSN
CO6	Understand the Application areas of WSN

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

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	H	H	M			H	H	M	H
	CO2	H	H	H	H	M			H	H	M	H
	CO3	H	H	H	H	M			H	H	M	H
	CO4	H	H	H	H	M			H	H	M	H
	CO5	H	H	H	H	M			H	H	M	H
	CO6	H	H	H	H	M			H	H	M	H

Category		Professional Elective(PE)
4	Approval	47th Meeting of Academic Council, Aug 2018

PROFESSIONA ELECTIVE - 5					
P18PEES051	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:NIL				
	Course Designed by: – Department of Electronics & Communication Engineering				

Course Objectives:

- To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
- To understand EMI sources and its measurements.
- To understand the various techniques for electromagnetic compatibility

SYLLABUS

UNIT I EMI ENVIRNONMENT 9

Sources of EMI, Conducted and radiated EMI, Transient EMI, EMI – EMC Definition and units of Parameters.

UNIT II EMI COUPLING, PRINCIPLES 9

Conducted, Radiated and Transient coupling, Common impedance ground coupling radiation common mode and ground loop coupling, radiated differential mode coupling near Field, cable to cable Coupling, power mains and power supply coupling.

UNIT III EMI SPECIFICATIONS / STANDARDS / LIMITS 9

Units of specifications civilian standard, military standards.

UNIT IV EMI MEASUREMENTS 9

EMI test instruments / systems, EMI test / EMI shielded chamber, open area test site, TEM cell antennas, conductors sensors / injectors / couplers, military test method and procedures, calibration procedures.

UNIT V EMI CONTROL TECHNIQUES & EMC DESIGN OF PCB'S 9

Shielding, filtering, grounding, bonding, isolation transformation, transient suppressor, cable routing, signal control, component selection and mounting.PCB traces crosstalk, impedance control, power distribution decoupling, zoning, mother board design and propagation delay models.

Total Periods: 45 Hours

TEXTBOOKS:

1. Bernard Keiser, "Principles of EMC" ,Artech House, 3rd, 1986.
2. Henry W. Ott "Noise Techniques in electronics systems" Willey and sons, New York, 1998.
3. B.P Kodali, "Engineering EMC Principles, Measurements and technologies", IEEE Press, 1996.

REFERENCE BOOK:

1. Christos christopoulos ,Principles and Techniques of Electromagnetic Compatibility, CRC Press, 2 edition (21 June 2007).

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Real-world EMC design constraints and make appropriate tradeoffs to achieve the most cost-effective design that meets all requirements
CO2	Designing electronic systems that function without errors or problems related to electromagnetic compatibility
CO3	Diagnose and solve basic electromagnetic compatibility problems
CO4	To be able to apply Maxwell's equations for electromagnetic systems.
CO5	To able to design systems to mitigate the effects of Electromagnetic Interference.
CO6	To design systems with Electromagnetic compatibility

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			M	H	H	M
	CO2	M	H	M	H	M			M	M	H	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	M	H	M	H			H	H	M	H
	CO6	H	M	M	H	H			M	M		H
3	Category	Professional Elective (PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEES052	**ADVANCED WIRELESS COMMUNICATION**	**L**	**T**	**P**	**C**

	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

To enable the student to understand the evolving paradigm of cooperative and green wireless communication concepts and the challenges and trade-offs involved in such networks.

SYLLABUS:

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations ; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment , Cooperative multicell processing techniques for energy-efficient cellular wireless communications.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TEXT BOOKS:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.
3. F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012.

REFERENCES:

1. Mazin Al Noor, “Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access”, GRIN Verlag, 2012.
2. Mohammad S. Obaidat, Alagan Anpalagan and Isaac Woungang, “Handbook of Green Information and Communication Systems”, Academic Press, 2012.
3. Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers, 2010.
4.Jinsong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.

COURSE OUTCOMES (COs)	
CO1	The student would be able to appreciate the necessity and the design aspects of cooperative and green wireless communication.
CO2	The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
CO3	The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.
CO4	The student able to understand the different power saving strategies and energy efficient signal, system and network design.
CO5	The student expose the energy saving techniques adopted in existing wireless components, protocols and networks.
CO6	The Students will have the knowledge about the evolution of green future wireless communication technologies.

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	H			H	H						
	CO2	H	H		H					M		M
	CO3	H	H		H	H				M		M
	CO4		M		H		M					
	CO5	M			M					H		
	CO6		H		H		L			H		M
3	Category	Professional Elective (PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEES053	**INTRODUCTION TO MEMS SYSTEM DESIGN**	**L**	**T**	**P**	**C**

	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components. And to introduce the students various opportunities in the emerging field of MEMS.

SYLLABUS

UNIT-I INTRODUCTION TO MEMS AND MICRO FABRICATION 9

History of MEMS Development, Characteristics of MEMS-miniaturization - micro electronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process- silicon based MEMS processes- new material and fabrication processing- points of consideration for processing.

UNIT-II ELECTRICAL & MECHANICAL PROPERTIES OF MEMS MATERIALS 9

Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- deflection of beam-longitudinal stain under pure bending spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

UNIT-III SENSING AND ACTUATION 9

Electrostatic sensing and actuation-parallel plate capacitor – Application-Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations-thermal sensors-Actuators- Applications- Inertial, Flow and Infrared sensors. Piezo-resistive sensors- piezo-resistive sensor material- stress in flexural cantilever and membrane Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF –ZnO Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation-Micro magnetic actuation principle- deposition of magnetic materials-Design and fabrication of magnetic coil.

UNIT-IV BULK AND SURFACE MICROMACHINING 9

Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micromachining process- structural and sacrificial material, stiction and antistiction methods, Foundry process.

UNIT- V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS- polymide-SU-8 liquid crystal polymer(LCP)-PDMS-PMMA-Parylene-Flurocorbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-mirrors-Actuation for active optical MEMS.

TEXT BOOK:

1.Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.

REFERENCES BOOKS:

1.Gaberiel M.Rebiz, "RF MEMS Theory,Design and Technology", John Wiley & Sons,2003
2.Charles P.Poole, Frank J.Owens, "Introduction to nanotechnology" John Wiley & sons, 2003.
3.Julian W.Gardner, Vijay K Varadhan, "Microsensors, MEMS and Smart devices", John Wiley & sons, 2001.

COURSE OUTCOMES (COs)	
CO1	Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
CO2	Understand the rudiments of Micro fabrication techniques
CO3	Identify and understand the various sensors and actuators
CO4	Be familiar with the important concepts applicable to MEMS, their fabrication
CO5	Applications of MEMS to disciplines beyond Electrical and Mechanical engineering
CO6	Be fluent with the design, analysis and testing of MEMS & apply the MEMS for different applications.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	H					M		
	CO3		M	H	H					M		
	CO4	M		M	H		H			M		H
	CO5	H	M	H	H		M			M		
	CO6	M	M	H	H		H			H	M	H
3	Category	Professional Electives(PE)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

OPEN ELECTIVES

P18OEES001	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Module 1 **9 Hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 **9 Hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 **9 Hours**

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module 4 **9 Hours**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model,

Overbooking Model, Cash Budget Model.

Module 5 **5 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module 6 **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002 **INDUSTRIAL SAFETY**

		L	T	P	C
P18OEMA002	**INDUSTRIAL SAFETY**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

Module 1 **9 Hours**

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.

Module 2 **9 Hours**

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.

Module 3 **9 Hours**

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

Module 4 **9 Hours**

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.

Module 5 **9 Hours**

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

Total No. of Periods: 45

References Books:

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.

P18OEME003 OPERATIONS RESEARCH

P18OEME003	OPERATIONS RESEARCH	L	T	P	C

	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

Module 1 **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module 2 **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3 **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 4 **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5 **9 Hours**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEBA004 COST MANAGEMENT OF ENGINEERING PROJECTS

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module 1: **9 Hours**

Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module 2: **10 Hours**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module 3:10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 4: **6 Hours**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005 COMPOSITE MATERIALS

P18OEME005	COMPOSITE MATERIALS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineer				

Module 1 **9 Hours**

Introduction

Definition – Classification and characteristics of Composite materials.Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2 **9 Hours**

Reinforcements

Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module 3 **9 Hours**

Manufacturing of Metal Matrix Composites

Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module 4 **9 Hours**

Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module 5 **9 Hours**

Strength

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE005 WASTE TO ENERGY

P18OEEE005	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

Module 1 **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2 **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3 **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4 **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5 **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status -

Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 & AUDIT 2

P18ACEN001	AUDIT : ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title

SYLLABUS:

UNIT I: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness.

UNIT II: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

UNIT III: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT IV: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

UNIT V: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	AUDIT: DISASTER MANAGEMENT	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I: **4 Hours**

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II: **4 Hours**

Repercussions Of Disasters And Hazards: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor

Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: **4 Hours**

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV: **4 Hours**

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **4 Hours**

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI: **4 Hours**

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	AUDIT : SANSKRIT FOR TECHNIC KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
Learning of Sanskrit to improve brain functioning.
Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.

The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III: **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

Understanding basic Sanskrit language

Ancient Sanskrit literature about science & technology can be understood.

Being a logical language will help to develop logic in students

P18ACBA004	**AUDIT : VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to

Understand value of education and self- development.
Imbibe good values in students.
Let the should know about the importance of character.

SYLLABUS:

UNIT I: **4 Hours**

Values and self-development –Social values and individualattitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.Value judgements

UNIT II: **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, CleanlinessHonesty, Humanity. Power of faith, National Unity.Patriotism. Love for nature, Discipline.

UNIT III: **6 Hours**

Personality and Behavior Development - Soul and Scientificattitude. Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

UNIT IV: **6 Hours**

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality ,Non violence ,Humility, Role of Women.All religions and same message.Mind your Mind ,Self-control.Honesty, Studying effectively.

Suggested reading

Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	AUDIT: CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS:

UNIT I: **4 Hours**

History of Making of the Indian Constitution: HistoryDrafting Committee, (Composition & Working)

UNIT II: **4 Hours**

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III: **4 Hours**

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**

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of MinistersJudiciary, 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, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

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.

Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I: **4 Hours**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and Searching.

UNIT II: **2 Hours**

Thematic overview:Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

UNIT III: **4 Hours**

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: **4 Hours**

Professional development:: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V: **2 Hours**

Research gaps and future directions: Research design,Contexts,Pedagogy Teacher education**,**Curriculum and assessment,Dissemination and research impact.

Suggested reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
- ✓ Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- ✓ Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- ✓ Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
- ✓ Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- ✓ www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- ✓ What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT: STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To achieve overall health of body and mind

To overcome stress

SYLLABUS:

UNIT I: **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II: **8 Hours**

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

Develop healthy mind in a healthy body thus improving social health also

Improve efficiency

P18ACBA008	**AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To learn to achieve the highest goal happily

To become a person with stable mind, pleasing personality and determination

To awaken wisdom in students

SYLLABUS:

UNIT I: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

UNIT II:

Approach to day to day work and duties. **8 Hours**

Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

UNIT III: **8 Hours**

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad BhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested reading

"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students

CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.Tech – VLSI DESIGN
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCVD011	PC	CMOS Device Modeling	3	3	0	0	3
2	P18PCVD101	PC	Logic system Design and verification	3	3	0	0	3
3		PE	Professional Elective – 1	3	3	0	0	3
4		PE	Professional Elective – 2	3	3	0	0	3
5	P18PRVD103		Research Methodology and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
7	P18PCVD1L1	PC	VLSI Design lab – I	4	0	0	4	2
8	P18PCVD1L2	PC	ASIC CAD lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCVD201	PC	Advanced Analog Integrated Circuits	3	3	0	0	3
2	P18PCVD202	PC	High speed VLSI	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		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCVD2L1	PC	Analog IC design lab	4	0	0	4	2
7	P18PCVD2L2	PC	VLSI Design Lab –II	4	0	0	4	2
8	P18PRVD2P1	PR	Mini Project with Seminar	4	0	0	4	2
Total				26	14	0	12	18

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective – 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRVD3P2	PR	Phase – I Dissertation	20	0	0	20	10
			Total	26	6	0	20	16

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRVD4P3	PR	Phase-II Dissertation	32	0	0	32	16
			Total	32	0	0	32	16

TOTAL CREDIT

18+18+16+16= 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE – 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**

1	P18PEMA106	PE	Advanced Mathematics for Electronics Engineers	3	3	0	0	3
2	P18PEVD012	PE	ASIC Design	3	3	0	0	3
3	P18PEVD013	PE	Hardware And Software Co design	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEVD021	PE	DSP Architecture and Application	3	3	0	0	3
2	P18PEVD022	PE	Digital Control Engineering	3	3	0	0	3
3	P18PEVD023	PE	Low power VLSI design	3	3	0	0	3

PROFESSIONAL ELECTIVE – 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEVD031	PE	Signal processing for system Design	3	3	0	0	3
2	P18PEVD032	PE	RF VLSI Design	3	3	0	0	3
3	P18PEVD033	PE	Design Of Semiconductor Memories	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**

1	P18PEVD041	PE	Non Linear Signal Processing	3	3	0	0	3
2	P18PEVD042	PE	Electromagnetic Interference And Compatibility in System Design	3	3	0	0	3
3	P18PEVD043	PE	CAD VLSI Circuits	3	3	0	0	3

PROFESSIONAL ELECTIVE – 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEVD051	PE	CMOS Analog VLSI	3	3	0	0	3
2	P18PEVD052	PE	Algorithm and architecture for signal processing ICS	3	3	0	0	3
3	P18PEVD053	PE	Introduction To MEMS System Design	3	3	0	0	3

OPEN ELECTIVE

S.No	**Code No.**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3

7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

Audit I& Audit II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18ACEN001	AC	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	AC	Disaster Management	2	2	0	0	0
3	P18ACEN003	AC	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	AC	Value Education	2	2	0	0	0
5	P18ACLW005	AC	Constitution of India	2	2	0	0	0
6	P18ACBA006	AC	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	AC	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	AC	Personality Development through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

P18PCVD011	**CMOS DEVICE MODELING**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

- To make the student understand how MOSFET and other semiconductor devices are modeled.
- To impart knowledge to simulate MOSFET for various operational requirements
- To impart a knowledge on advanced structures of MOSFETs like SOIFET, FinFET

UNIT I - ELECTRON AND HOLE DENSITIES IN EQUILIBRIUM 9

Fermi – Dirac Statistics, Carrier concentration, Fermi level at equilibrium, recombination, Mobility of carriers, charge transport in semiconductors.

UNIT II - PN JUNCTION 9

PN Junction under thermal equilibrium under applied bias, Transient Analysis, Injection and Transport model, Diode small signal and large signal model.

UNIT III – MOSFET 9

Operation of Ideal MOS diode, Effects of mobile Ionic charges, Oxide charges and Interface states, C-V Characteristics, Threshold voltage of MOSFET, Bulk charge model, square law method (Level 1 is SPICE), Level 3 model in SPICE, BSIM Models.

UNIT IV - SECOND ORDER EFFECTS IN MOSFET 9

Effect of Gate voltage on carrier mobility, Effect of Drain voltage on carrier mobility, Channel length modulation, Breakdown and punch through, Subthreshold current, Short channel effects., Meyer's model, Small signal model.

UNIT V - ADVANCED TOPICS 9

MOSFET scaling, Non-uniform doping in channel, SOI MOSFET, Buried channel MOSFET, Fin FET.

REFERENCES

1. Nandita Das Gupta, Amitava Das Gupta, "Semiconductor devices, modeling and Technology", Prentice Hall of Indis, 2004.

2. Philip.E.Allen Douglas, R. Hoberg, "CMOS Analog circuit Design", second edition, Oxford Press, 2002. 3. S.M. Sze, "Semiconductor Devices-Physics and Technology", John Wiley and Sons, 1985.

4. KiatSeng Yeo, Samir R.Rofail, Wang-Ling Gob, "CMOS/BiCMOS VLSI-Low Voltage, Low Power", Pearson Education, Low price edition, 2003.

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts related to semiconductors
CO2	To understand about the operation of PN junction diode
CO3	To learn about MOSFET and its parameters.
CO4	To gain knowledge about the second order effects in MOSFET
CO5	To learn about scaling in MOSFET
CO6	To learn about FinFET 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
2	CO1	H	H			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
3	Category	Professional Core										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCVD101	**LOGIC SYSTEM DESIGN AND VERIFICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

The Course aims at covering the important problems/algorithms/tools so that students get a comprehensive idea of the whole digital design flow..

UNIT I : INTRODUCTION 9

Introduction to Digital VLSI Design Flow-: High Level Design Representation-Transformations for High Level Synthesis-Introduction to HLS:Scheduling,Allocation and Binding Problem-Scheduling Algorithms-Binding and Allocation Algorithms

UNIT II : LOGIC OPTIMIZATION AND SYNTHESIS 9

Two level Boolean Logic Synthesis-Heuristic Minimization of Two-Level Circuits-: Finite State Machine Synthesis-Multilevel Implementation

UNIT III : VERIFICATION 9

Introduction to formal methods for verification-Temporal Logic: Introduction and Basic OperatorsSyntax and Semantics of CTL-Equivalence between CTLFormulasBinary Decision Diagram: Introduction and construction Lecture-II: Ordered Binary Decision Diagram Lecture-III: Operations on Ordered Binary Decision Diagram Lecture-IV: Ordered Binary Decision Diagram for Sequential CircuitsSymbolic Model Checking

UNIT IV DIGITAL TESTING 9

Introduction to Digital VLSI Testing - Functional and Structural Testing - Fault Equivalence - Fault Simulation and Testability Measures - Fault Simulation - Testability Measures (SCOAP)

UNIT V COMBINATIONAL CIRCUIT TESTING AND SEQUENTIAL CIRCUIT TESTING 9

Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras -D-Algorithm Sequential Circuit Testing and Scan Chains - ATPG for Synchronous Sequential Circuits- Scan Chain based Sequential Circuit Testing - Built in Self test (BIST) - Memory Testing

Text Book:

1. D. D. Gajski, N. D. Dutt,A.C.-H. Wu and S.Y.-L. Lin, High-Level Synthesis: Introduction to Chip and System Design,Springer, 1st edition, 1992.
2. S.Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis,Prentice Hall, 2nd edition, 2003.

References:

1. G. De Micheli.Synthesis and optimization of digital circuits, 1st edition, 1994.

2. M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning about systems, Cambridge University Press, 2nd Edition, 2004
3. Bushnell and Agrawal,Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits,Kluwer Academic Publishers, 2000

COURSE OUTCOMES (COs)	
CO1	To learn the VLSI Design flow
CO2	To understand about the optimization concepts.
CO3	To learn about verification concepts.
CO4	To gain knowledge about the basics of Testing
CO5	To learn about testing of combinational circuits
CO6	To learn about testing of 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			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
3	Category	Professional Core										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PRVD103	**RESEARCH METHODOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

Student will understand research problem formulation and Analyze research related information

SYLLABUS

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright.
Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

REFERENCES

1.Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

2. Business Research Methods – Alan Bryman& Emma Bell, Oxford University Press.

3. Research Methodology – C.R.Kothari

4. Select references from the Internet

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To understand the Approaches of investigation of solutions for research problem
CO2	Students to analysis Plagiarism
CO3	To able to understand the Effective technical writing
CO4	Nature of Intellectual Property
CO5	Understand the concept of Patent Rights
CO6	To gain knowledge in New Developments in IPR

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

1	COs/Pos	A	b	c	d	e	f	g	h	i	j	k	PSO1	PSO2
2	CO1	M	H	H		H						H	H	
	CO2	M	H	H		H						L		
	CO3	M				M			H			L		H
	CO4	M	H	L		H			M			H		M
	CO5	M		M		M			L				L	L
	CO6	M				L			H	M				H

3	Category	PROFESSIONAL CORE COURSES (PCC)		
4	Approval	47th Meeting of Academic Council, Aug 2018		

P18PCVD1L1	**VLSI DESIGN LAB I**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – Digital VLSI CMOS				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To learn about the design of digital circuits using Hardware description languages

LIST OF EXPERIMENTS

(ALL SHOULD BE DONE USING VERILOG HDL & VHDL CODE ON FPGA)

1. DESIGN AND TESTING OF HALF ADDER, FULL ADDER.
2. DESIGN AND TESTING OF HALF SRACTOR/FULL SUBTRACTOR.
3. DESIGN AND TESTING OF MULTIPLEXER, DEMULTIPLEXER.
4. DESIGN AND TESTING OF ENCODER, DECODER.
5. DESIGN AND TESTING OF MAGNITUDE COMPARATOR WITH 8 BITS.
6. DESIGN AND TESTING OF CODE CONVERTERS.
7. DESIGN AND TESTING OF JK, D, T, SR FLIPFLOPS.
8. DESIGN AND TESTING OF COUNTERS.
9. DESIGN AND TESTING OF UP/DOWN COUNTERS, RAM & ROM.
10. DESIGN AND TESTING OF N- BIT SHIFT REGISTERS.
11. DESIGN AND TESTING OF ALU.

COURSE OUTCOMES (COs)
Students will be able to:

CO1	To learn about the design of digital circuits of HALF ADDER, FULL ADDER Hardw description languages
CO2	To learn about the design of digital circuits of HALF SUBTRACTOR/FULL SUBTRACTOR
CO3	To learn about the design of digital circuits of MULTIPLEXER, DEMULTIPLEXER using Hardware description languages
CO4	To learn about the design of digital circuits of ENCODER, DECODER using Hardware descrip languages
CO5	To learn about the design of digital circuits of JK, D, T, SR FLIPFLOPS
CO6	Students will be able to design and implement digital logic circuits on FPGA

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low														
1	COs/Pos	A	b	c	D	e	F	g	h	i	j	k	PSO1	PSO2
2	CO1	H	H	H	M	M		L	L	M	L	M	H	H
	CO2	H	H	H	M	M		L	M	M	L	M	H	H
	CO3	H	H	H	M	M		M	M	M	M	M	H	H
	CO4	H	H	H	M	M		M	M	M	M	M	H	H
	CO5	H	H	H	M	M		M	M	M	L	M	H	H
	CO6	H	H	H	M	M		M	M	M	M	M	H	H
3	Category	PROFESSIONAL CORE COURSES (PCC)												
4	Approval	47th Meeting of Academic Council, Aug 2018												

Course Code P18PCVD1L2	Course Name: ASIC CADD LAB	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: ASIC Design				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To learn about the design of ASIC CADD Circuits. .

List of Experiments

1. Adder/ Subtractor
2. Multiplexer/ Demultiplexer
3. 8-bit Counter
4. Signed Pipelined Multiplier
5. Accumulator
6. MAC
7. Memory

The above experiments are carried out using the following tools:

1. Model SIM
2. Cadence
3. Synopsis
4. Mentor Graphics
5. Xilinx Planahead

COURSE OUTCOMES (COs)	
CO1	To learn about the design ofAdder/ Subtractor
CO2	To learn about the design ofMultiplexer/ Demultiplexer

CO3	To learn about the design of 8-bit Counter
CO4	To learn about the design ofSigned Pipelined Multiplier
CO5	To learn about the design of Accumulator
CO6	To learn about the design of MAC and Memory

Mapping of Course Outcomes with Student Outcomes (SOs)
(S/M/L 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	M	M	H	H	M		L	M	M	L	M
	CO2	M	H	H	M	M		M	M	M	L	M
	CO3	L	L	M	L	M		M	L	M	L	L
	CO4	L	M	M	L	M		M	H	M	L	L
	CO5	M	H	H	M	L		M	M	M	L	L
	CO6	M	H	H	M	L		M	L	M	M	M
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

SEMESTER II

Course Code P18PCVD201	**Course Name: ADVANCED ANALOG INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Linear Integration Circuits				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To design the single stage amplifiers using pmos and nmos driver circuits with different loads and analyze high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers.

SYLLABUS

UNIT-I CIRCUIT CONFIGURATION FOR LINEAR IC (9 HOURS)

Current source, analysis of difference amplifiers with active load, Supply and temperature independent biasing techniques, voltage references.

UNIT-II OPERATIONAL AMPLIFIERS (9 HOURS)

Analysis of operational amplifier circuits, slew rate model and high frequency analysis, operational amplifier noise analysis and low noise operational amplifiers.

UNIT-III ANALOG MULTIPLIER AND PLL (9 HOURS)

Analysis of MOS operational Amplifier, CMOS voltage references, MOS Power amplifier and analog switches.

UNIT-IV MOS ANALOG ICS (9 HOURS)

Design of MOS Operational Amplifier,CMOS Voltage references,MOS power amplifier and analog switches.

UNIT-V MOS SWITCHED CAPACITOR FILTERS (9 HOURS)

Design techniques for switched capacitor filter, CMOS switched capacitor filters, MOS integrated active RC filters.

TEXT BOOK:

1.KennethR.Laker, Willy M.C.Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems ", McGraw Hill, 1994.
2. BehzadRazavi, "Principles of Data Conversion System Design", S.Chand&Company ltd, 2000.

REFERENCES BOOK:

1.Gray and Meyer, "Analysis and Design of Analog IC's, Wiley International, 1996.
2.Gray, Wooley, Broderson, "Analog MOS Integrated Circuits", IEEE Press 1989.

COURSE OUTCOMES (COs)	
CO1	Ability to analyze the design of single and two stage operational amplifiers and voltage references, and determine the device dimensions of each MOSFETs involved.
CO2	To understand the design techniques of switched capacitor filters
CO3	To study the different types of current mirrors
CO4	To know the concepts of voltage and current reference circuits
CO5	To understand about MOS switched capacitor filters.
CO6	Students will demonstrate their knowledge by designing analog circuits.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	M		L	M	M	L	M
	CO2	M	H	H	M	M		M	M	M	L	M
	CO3	L	L	M	L	M		M	L	M	L	L
	CO4	L	M	M	L	M		M	H	M	L	L

	CO5	M	H	H	M	L		M	M	M	L	L
	CO6	M	H	H	M	L		M	L	M	M	M
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCVD202	**HIGH SPEED VLSI**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – VLSI Design				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:
This course is aimed at providing high speed design techniques for use in VLSI design

SYLLABUS

UNIT I CLOCKED LOGIC STYLES 9
Clocked Logic Styles, Single-Rail Domino Logic Styles, Dual-Rail Domino Structures, Latched Domino Structures, Clocked pass Gate Logic Non Clocked Logic Styles, Static CMOS, DCVS Logic, Non-Clocked pass Gate Families.

UNIT II - CIRCUIT DESIGN MARGINING AND DESIGN VARIABILITY 9
Circuit Design Margining, Design Induced Variations, Process Induced Variations, Application Induced Variations, Noise.

UNIT III - LATCHING STRATEGIES 9
Latching Strategies, Basic Latch Design, Latching Differential Logic, Race Free Latches for Pre-charged Logic, Asynchronous Latch Techniques.

UNIT IV - INTERFACE TECHNIQUES 9
Signaling Standards, Chip-to-Chip Communication Networks, ESD Protection, Skew Tolerant Design.

UNIT V - CLOCKING STYLS 9
Clocking Styles, Clock Jitter, Clock Skew, Clock Generation, Clock Distribution, Asynchronous Clocking Techniques.

TEXT BOOKS:
1.Kerry Bernstein, Keith M. Carrig, *"High Speed CMOS Design Styles",*Kluwer Academic Publishers, 2002.

REFERENCES:

1. Evan Sutherland, Bob Stroll, David Harris," *Logical Efforts,Designing Fast CMOS Circuits",* Kluwer Academic Publishers, 1999

2. David Harris, *"Skew Tolerant Domino Design",* IEEE Journal of Solid State Circuits, 2001..

COURSE OUTCOMES (COs)												
CO1	To gain knowledge on circuits and techniques involved in high speed VLSI circuits.											
CO2	To explore various design strategies to be followed for designing a high speed VLSI circuits.											
CO3	To understand the logic styles for designing a high speed VLSI circuit											
CO4	To acquire knowledge on the design of Latching Strategies.											
CO5	To explore the various performance of Interface techniques.											
CO6	To gain knowledge about the Clocking Stylesinvolved in high speed VLSI circuits.											
Mapping of Course Outcomes with Student Outcomes (SOs) (S/M/L 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	H			H	H						
	CO2	H	H		H					M		M
	CO3	H	H		H	H				M		M
	CO4		M		H		M					
	CO5	M			M					H		
	CO6		H		H		L			H		M
3	Category											
4	Approval	47th Meeting of Academic Council, Aug 2018										

Course Code P18PCVD2L3	**Course Name: ANALOG INTEGRATED CIRCUITS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: linear integrated circuits				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To learn about the design of integrated circuits.

List of Experiments

1. Characteristics of NMOS & PMOS Transistor
2. Design of Common Source Amplifier with different Loads
3. Design of Common Gate Amplifier
4. Design of Common Drain Amplifier
5. Design of Single stage Cascade Amplifiers
6. Design of Current Mirrors
7. Design of Differential Amplifiers with Different Loads
8. Design of Two stage Opamp
9. Design of Telescopic Cascade Opamp
10. Design of Folded Cascade Opamp

COURSE OUTCOMES (COs)	
CO1	To learn about the design andCharacteristics of NMOS & PMOS Transistor.
CO2	To learn about the design ofCommon Source Amplifier with different Loads.
CO3	To learn about the design ofCommon Gate Amplifier and Common Drain Amplifier.
CO4	To learn about the design ofSingle stage Cascade Amplifiers and Current Mirrors.
CO5	To learn about the design ofDifferential Amplifiers with Different Loads.
CO6	To learn about the design ofTwo stage Opampand Telescopic Cascade Opamp.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	M		L	M	M	L	M
	CO2	M	H	H	M	M		M	M	M	L	M
	CO3	L	L	M	L	M		M	L	M	L	L
	CO4	L	M	M	L	M		M	H	M	L	L
	CO5	M	H	H	M	L		M	M	M	L	L
	CO6	M	H	H	M	L		M	L	M	M	M
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PCVD2L4	**Course Name: VLSI DESIGN LAB II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45		0	0	4 2
	Prerequisite: VLSI design lab I				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

To learn about the design of VLSI circuits.

LIST OF EXPERIMENTS:

1. Introduction to layout design rules

Layout, physical verification, placement & route and static timing analysis for the following:

2. CMOS inverter
3. CMOS NOR/ NAND gates
4. CMOS XOR and MUX gates
5. CMOS half adder and full adder
6. Static / Dynamic logic circuits (register cell)
7. Latch
8. Pass transistor
9. Layout of any combinational circuit (complex CMOS logic gate)- Learning about data paths
10. Introduction to SPICE simulation and coding of NMOS/CMOS circuit
11. SPICE simulation of basic analog circuits: Inverter / Differential amplifier
12. Analog Circuit simulation (AC analysis) – CS & CD amplifier
13. System level design using PLL

COURSE OUTCOMES (COs)	
CO1	To understand about layout in VLSI design
CO2	To understand about SPICE simulation of basic analog citcuits.
CO3	To understand about placement and routing in VLSI design
CO4	To understand about SPICE simulation of basic Digital citcuits.
CO5	To understand about routing in VLSI design
CO6	To understand system level designing

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	H	H	M	M		M	M	H	M	H
	CO2	M	H	H	H	M		M	M	H	M	H

	CO3	L	M	H	M	M		L	M	M	L	M
	CO4	M	H	H	H	M		M	M	H	M	H
	CO5	L	M	H	M	M		L	M	M	L	M
	CO6	M	H	H	M	L		L	M	M	L	M
3	Category	Department of ECE										
4	Approval	37th - 40th Meetings of Academic Council, May 2018										

PROFESSIONAL ELECTIVES

P18PEMA10(	**Advanced Mathematics for Electronics Engineers**	**L**	**T**	**P**	**C**
	Total Contact Hours:60	3	1	0	3
	Prerequisite :ENGINEERING MATHEMATICS				
	Course Designed by : Dept of Mathematics				

OBJECTIVES

To apply all taught techniques to unseen problems, and queuing is a major branch of optimization, Random variable compute and interpret means, correlation/covariance, PERT and CPM chart is mainly used for documenting the data(visually) on projects.

SYLLABUS

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables and their functions - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Exponential, Gamma, Weibull and Normal distributions.

UNIT II MATRIX THEORY 12

Eigen values using QR Transformations generalized eigenvectors – Canonical forms, singular valued composition and application – matrix norms and induced norms Psuedo inverse – least square approximations

UNIT III SPECIAL FUNCTIONS 12

Bessel's Equation- Bessel Functions- Legendre's Equation- Legendre Polynomials- Rodrigue's Formula- Recurrence Relations- Generating Functions and Orthogonal Property for Bessel Function of the First Kind.

UNIT IV OPERATIONS RESEARCH 12

Network Definitions – Minimal Spanning Tree algorithm – Shortest Route Problem – Maximal Flow model – Minimum Cost Capacitated Flow Problem – CPM and PERT.

UNIT V QUEUING THEORY 12

Single and Multiple Server Markovain Queuing Models – Customer Impatience Priority Queues M/g / I Queuing System –Queuing Applications.

TEXT BOOKS:

1. Handy A.Taha., "Operations Research An Introduction", 7th Edn. Pearson Education , Chennai-113. 2002.
2. Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 2nd Edn.
3. Wiley India Pvt Ltd, New Delhi.

R**EFERENCE BOOKS:**

1. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi. 1994.
2. Gupta.SC and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.
3. Stewart G.W. "Introduction to Matrix Computaions" Academic Press, New York.

COURSE OUTCOMES (COs)	
CO1	The student will learn to analyse and solve the fundamental problems with prescribed conditions in simple cases.
CO2	The student will learn to understand how signals, systems, inference combine in prototypical tasks of communication.
CO3	The student will learn to manipulate matrices and to do matrix algebra, determinants, eigen values Eigen vectors and to solve the system of linear equations.
CO4	The student will learn to understand how signals, systems, control.
CO5	The student will learn to understand how signals, systems, signal processing.
CO6	Thestudent will learn operation research methodology.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			H	H		H
	CO2	H	H	M	H	H			H	H	M	H

	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	H	M	H				M	M	M	
	CO6	H	M	M	H	H			H	M		
3	Category	PE										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD012	**ASIC DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – VLSI Design				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To learn the fundamentals of ASIC and its design methods

UNIT – I:INTRODUCTION TO ASIC, CMOS LOGIC AND ASIC LIBRARY DESIGN9

Capacitance – Logical Effort – Library Cell Design – Library Architecture Types of ASIC **–** Design Flow – CMOS Transistors – CMOS Design Rules – Combinational Logic Cell – Sequential Logic Cell – Data Path Logic Cell – Transistors as Resistors – Transistor Parasitic**.**

UNIT –II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS

AND PROGRAMMABLE ASIC I/O CELLS.9

Anti fuse – Static RAM – EPROM and EEPROM Technology – PREP Bench Marks – Acted ACT – Xilinx LCA – Altars FLEX – Alters MAX – DC & AC Input and Output – Clock and Power Input – Xilinx I/O Blocks.

UNIT – III PROGRAMMABLE ASICS INTERCONNECT, PROGRAMMABLE ASIC

DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY. 9

Acted ACT - Xilinx LCA - Xilinx EPLD - Alters MAX 5000 & 7000 - Alters MAX 9000 - Alters FLEX – Design System – Logic Synthesis – Half Gate ASIC – Schematic Entry – Low Level Design Language – PLA Tools – EDIF – CFI Design Representation**.**

UNIT – IV LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Verilog and Logic Synthesis– VHDL and LOGIC Synthesis– Types of Simulation – Boundary Scan Test– Fault Simulation- Automatic Test Pattern Generation.

UNIT–V ASICS CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING. **9**

System Partition – FPGA Partitioning – Partitioning Methods – Floor Planning – Placement – Physical Design Flow – Global Routing – Detailed Routing – Special Routing –Circuit Extraction – DRC.

TEXT BOOK:

1. M. J. S. Smith, "Application Specific Integrated Circuits" , Addison – Wesley L Ongnam Inc., 1997.

REFERENCE BOOK:

1. Andrew Brown, "VLSI Circuits and Systems in Silicon", McGraw Hill 1991.
2. S. D. Brown, R. J. Francis, J. ROX, Z. G. Urines, "Field Programmable Publishers, 1992.
3. Mohammed Ismail and Terri Fief, "Analog VLSI and Modern Signal Processing," McGraw Hill 1994.
4. S. Y. Kang, H. J. While Hours, T. Kailath, "VLSI Modern Signal Processing," Prentice Hall, 1985. Jose E. France, Yantis Tsividis, "Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge about CMOS design rules and ASIC cell libraries
CO2	To gain knowledge on programmable architectures for ASICs
CO3	To gain knowledge on programmable interconnect for ASICs
CO4	To understand about logic synthesis
CO5	To understand about testing methods
CO6	To understand the Asics Construction, Floor Planning, Placement And Routing

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L 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	M	H	H		M				M		M
	CO2	M	H	H		M			H	H	H	H
	CO3	M		M		M			M		M	
	CO4	H	H		H					H		H
	CO5	H	H		H				M	M		
	CO6	M	H	H	H	H			H	H	H	H
	Category	Professional Elective										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD013	**HARDWARE AND SOFTWARE CO-DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – VLSI Design				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

To acquire the knowledge about system specification and modeling. To learn the formulation of partitioning. To analyze about co-synthesis. To study the different technical aspects about prototyping and emulation. To formulate the design specification and validate its functionality by simulation.

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modelling , Co-Design for Heterogeneous Implementation – Processor Synthe Single-Processor Architectures with one ASIC, Single-Processor Architectures with many ASICs, Multi-Processor Architectures, Comparison of Co-Design Approaches, Models of Computation ,Requirements for Embedded System Specification.

UNIT II HARDWARE/SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem ,

Optimization , HW /SW Partitioning based on Heuristic Scheduling, HW /SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments,Future Developments in Emulation and Prototyping ,Target Architecture - Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL:45 PERIODS

REFERENCES:

1. Ralf Niemann , “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne W olf ,”Hardware/Software Co-Design: Principles and Practice”, Kluwer Academic Pub,1997.
3. Giovanni De Micheli , Rolf Ernst Morgon,” Reading in Hardware/Software Co-Design“ Kaufmann Publishers,2001.

COURSE OUTCOMES (COs)	
CO1	To gain knowledge about Hardware/Software Co-Design, Co-Design for System Specification and Modelling.
CO2	To gain knowledge on Multi-Processor Architectures, Comparison of Co-Design Approaches
CO3	To gain knowledge on Formulation of the HW/SW Partitioning Problem
CO4	To understand about The Co-Synthesis Problem, State-Transition Graph
CO5	To understandaboutPrototyping and Emulation Techniques , Prototyping and Emula Environments
CO6	To understand the Languages for System-Level Specification and Design Syst Level Specification.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L 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	M	H	H		M				M		M
	CO2	M	H	H		M			H	H	H	H
	CO3	M		M		M			M		M	
	CO4	H	H		H					H		H
	CO5	H	H		H				M	M		
	CO6	M	H	H	H	H			H	H	H	H
	Category	Professional Elective										
4	Approval	47th Meeting of Academic Council, Aug 2018										

		L	T	P	C
P18PEVD021	**DSP ARCHITECTURE & APPLICATION**				
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Digital signal processing				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To provide in-depth knowledge on Digital Signal Processor basics.
- Third generation DSP Architecture and programming skills.

SYLLABUS

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSP 9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction– DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV ADSP PROCESSOR 9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT VADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family.

TEXTBOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSPMicroprocessors with Examples from TMS320C54xx, cengage Learning India PrivateLimited, Delhi 2012
2. Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. NewDelhi, 2003.
3. RulphChassaing, Digital Signal Processing and Applications with the C6713 and C6416DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005

REFERENCES:

1.B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture.

COURSE OUTCOMES (COs)	
CO1	To understand about the basics of programmable DSPs
CO2	To understand the architecture and features of TMS320C5X Processor
CO3	To understand the architecture and features of TMS320C6X Processor
CO4	To gain knowledge about the Advanced DSP architectures and some applications.
CO5	To learn about the filter design.
CO6	To gain knowledge about the advanced processors and to compare the various Features of DSP Processors

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	H					M		
	CO3		M	M	H					M		
	CO4	M		M	H		H			M		H
	CO5	H	M	H	H		M			M		
	CO6	M	M	H	H		H			H	M	H
3	Category	Professional Electives										
4	Approval	47th Meeting of Academic Council, Aug 2018										

		L	T	P	C
P18PEVD022	**DIGITAL CONTROL ENGINEERING**				
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

To understand about digital control design.

SYLLABUS

UNIT I -INTRODUCTION TO DIGITAL CONTROL 9

Introduction, Structure of digital control system,Analog systems with piecewise constant inputs,Difference equations, The z-transform, Computer-aided design, Frequency response of discrete-time systems

UNITII MODELING OF DIGITAL CONTROL SYSTEMS 9

ADC model , DAC model , The transfer function of the ZOH, DAC, analog subsystem, and ADC combination transfer function, Systems with transport lag, The closed-loop transfer function, Analog disturbances in a digital system, Steady-state error and error constants, MATLAB commands

UNIT III –ANALOG AND DIGITAL CONTROL SYSTEM DESIGN 9

Root locus using MATLAB, Design specifications and the effect of gain variation, Root locus design, Empirical tuning of PID controllers, z-Domain root locus, z-Domain digital control system design, Digital implementation of analog controller design, Direct z-domain digital controller design , Frequency response design, Direct control design.

UNIT IV STATE SPACE REPRESENTATION 9

State variables, Statespace representation, Linearization of nonlinear state equations, the solution of linear statespace equations. The transfer function matrix, Discrete-time statespaceequations , Solution of discrete-time statespace equations, z-Transfer function from statespace equations, Similarity Transformation

UNIT V ELEMENTS OF NONLINEAR DIGITAL CONTROL SYSTEMS 9

Discretization of nonlinear systems , Nonlinear difference equations,Equilibrium of nonlinear discrete-time systems,Lyapunov stability theory, Stability of analog systems with digital control, State plane analysis, Discrete-time nonlinear controller design, Input-output stability and the small gain theorem, Design of the hardware and software architecture .

TOTAL: 45 PERIODS

REFERENCES:

Digital Control Engineering, M.SamiFadali, Antonio Visioli

COURSE OUTCOMES (COs)	
CO1	To understand about Structure of digital control system,Analog systems with piecewise constant inputs
CO2	To understand about ADC model , DAC model , The transfer function of the ZOH, DAC
CO3	To understand about The closed-loop transfer function, Analog disturbances in a digital system
CO4	To understand about Root locus using MATLAB, Design specifications and the effect of gain variation
CO5	To understand about The transfer function matrix, Discrete-time statespace equations
CO6	To understand about Discretization of nonlinear systems , Nonlinear difference equations,Equilibrium of nonlinear discrete-time systems

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	H					M		
	CO3		M	M	H					M		
	CO4	M		M	H		H			M		H
	CO5	H	M	H	H		M			M		
	CO6	M	M	H	H		H			H	M	H
3	Category	Professional Electives										

4	Approval	47th Meeting of Academic Council, Aug 2018

P18PEVD023	**LOW POWER VLSI DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – VLSI Design				
	Course Designed by – Dept. of Electronics and Communication Engineering.				

OBJECTIVES

- To know the sources of power consumption in CMOS circuits and to understand the various power reduction techniques and the power estimation methods.

UNIT I POWER DISSIPATION IN CMOS

9Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.

UNIT II POWER OPTIMIZATION 9

Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power system – reducing power consumption in memories –low power clock, Inter connect and layout design – Advanced techniques –Special techniques.

UNIT IV POWER ESTIMATION 9

Power Estimation techniques – logic power estimation – Simulation power analysis – Probabilistic power analysis.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power – Behavioral level transform – software design for low power.

Text Books:

1. Gary Yeap “Practical Low Power Digital VLSI Design”, 1997.

2. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.

References:

1 DimitriosSoudris, ChirstianPignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2002.

2. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999.

3..A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995.

4. AbdelatifBelaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995.

5. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001.

COURSE OUTCOMES (COs)	
CO1	Identify sources of power in an IC
CO2	Identify the power reduction techniques based on technology independent and technol dependent
CO3	Power dissipation mechanism in various MOS logic style.
CO4	Identify suitable techniques to reduce the power dissipation.
CO5	To learn about power estimation techniques
CO6	Design memory circuits with low power dissipation

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L 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			M			M	M		M
	CO2	H	H	H	H	H			H	H	H	H
	CO3	H	H	M	M	M			M		M	
	CO4	H	H		H	H				H		H
	CO5	H	H			H			M	M		
	CO6	M	H	H	H	H			H	H	M	H
		Professional Elective										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD031	**SIGNAL PROCESSING FOR SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Digital signal processing				
	Course Designed by : Dept. of Electronics And Communication Engineering				

OBJECTIVES

- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction and filtering concepts and techniques.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Auto-correlation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem–Finite Data records,Simulation of uniformly distributed/Gaussian distributed white noise – Simulation of Sine wave mixed with Additive White Gaussian Noise.

UNIT II SPECTRUM ESTIMATION 9

Bias and Consistency of estimators - Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method - Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion – Wiener filter - Discrete Wiener Hoff equations – Mean square error.

UNIT IV ADAPTIVE FILTERS 9

Recursive estimators - Kalman filter - Linear prediction – Forward prediction and Backward prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS – Sliding window RLS - Simplified IIR LMS Adaptive filter.

TOTAL PERIODS : 45

TEXTBOOKS:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
2. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.

REFERENCE BOOKS:

1. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
4. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood

Cliffs, NJ1988

COURSE OUTCOMES (COs)	
CO1	Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
CO2	State Parseval's theorem, W-K theorem, principle of orthogonality, spectral factorization theorem, Widrow-Hoff LMS algorithm and Shannon's sampling theorem, and define linear
CO3	Explain various noise types, Yule-Walker algorithm, parametric and non-parametric methods, Wiener and Kalman filtering, LMS and RMS algorithms, Levinson Durbin algorithm, adaptive noise cancellation and adaptive echo cancellation, speed verses convergence issues, channel equalization, sampling rate change, subband coding and wavelet transform.
CO4	Calculate mean, variance, auto-correlation and PSD for WSS stochastic processes, and derive prediction error criterion, Wiener-Hoff equations, Parseval'stheorem,W-K

	theorem and normal equations.
CO5	Design AR, MA, ARMA models, Weiner filter, anti aliasing and anti imaging filters, and develop FIR adaptive filter and polyphase filter structures.
CO6	Simulate spectral estimation algorithms and basic models on computing platform.

	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	l
2	CO1						M						
	CO2	M			H				L	M			
	CO3		M										L
	CO4					L		M				M	
	CO5	H		L	M					M	M		
	CO6												
3	Category		Engg Sciences (ES)										
4	Approval		47th Meeting of Academic Council, Aug 2018										

P18PEVD032	**RF VLSI DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – VLSI Design,RFID				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

- To explore the various performance measures of RF circuits

- To acquire knowledge on the design of RF filters, amplifiers and oscillators.

SYLLABUS:

UNIT I - PERFORMANCE PARAMETERS OF RF CIRCUITS (9 hours)

Gain Parameters, Non-linearity parameters, Noise figure, Phase Noise, Dynamic range, RF front end performance parameters, performance trade offs in an RF circuit

UNIT II - FILTER DESIGN (9hours)

Modern filter design, Frequency and impedance scaling, High Pass filter design, Band pass filter design, Band reject filter design, the effects of finite Q

UNIT III - HIGH FREQUENCY AMPLIFIER DESIGN (9hours)

Zeros as Bandwidth enhances, Shunt-series Amplifier, Bandwidth enhancement with frequency Doublers, Tuned amplifiers, Neutralization and unilateralization, cascaded Amplifiers, LNA Topologies.

UNIT IV - MIXERS AND OSCILLATORS (9hours)

Mixer fundamentals, Non linear systems as Linear mixers, multiplier based mixers, Sub sampling mixers. Problems with purely linear oscillators, Tuned oscillator, Negative Resistance oscillators, frequency synthesis

UNIT V - RF POWER AMPLIFIERS (9hours)

General considerations, Class A, AB, B & C Power amplifier, Class D, E & F amplifiers, modulation of power amplifiers, RF Power amplifier design examples.

REFERENCES

1. AleksandarTasic, Wouter.A.Serdijn, John.R.Long, "Adaptive Low Power Circuits for Wireless Communication (Analog Circuits and Signal Processing)", Springer, 1st Edition, 2006.

2. Chris Bowick, "RF Circuit design", Newnes (An imprint of Elesvier Science), 1st Edition, 1997.

3. Thomas.H. Lee, "The design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2nd Edition, 2004

COURSE OUTCOMES (COs)	
CO1	Perform calculation related to modulation and detection
CO2	Perform calculation related System Design Considerations

CO3	Design of Critical Components in CMOS RF-IC Design
CO4	Perform matching with complex loads
CO5	Design of CMOS Low-Noise Amplifier and Mixer
CO6	Perform small signal conversion gain simulation

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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						M					
	CO2	M			H				L	M		
	CO3		M									
	CO4					L		M				M
	CO5	H		L	M					M	M	
	CO6											
3	Category	Professional Electives										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD033	**DESIGN OF SEMICONDUCTOR MEMORIES**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basic VLSI Design				
	Course Designed by : Dept. of Electronics And Communication Engineering				

Course Objectives:

To study the architectures for SRAM and DRAM and To know about various non-volatile memories and To study the fault modelling and testing of memories for fault detection and To learn the radiation hardening process and issues for memory.

SYLLABUS

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 IVSEMICONDUCTOR 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 VADVANCED 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) – xperimental 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 BOOKS:

1.Ashok K. Sharma, “Semiconductor Memories Technology, Testing, and Reliability”, Prentice Hall of India Limited. New Delhi 1997.

2. Ashok K. Sharma, “Advanced Semiconductor Memories: Architectures, Designs, and Applications”, IEEE Press-2002.

REFERENCES BOOK:

1.Gray and Meyer, “Analysis and Design of Analog IC‘s, Wiley International, 1996.

2.GeraldLuecke, Jack P. Mize and William N. Carr, “SemiconductorMemoryDesignand

Application”, texas instruments-2005.

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	To know the design of MOS memories and the various precautionary methods to used in their design.
CO2	To gain knowledge on various testing methods of semiconductor memories.
CO3	To get an overview on reliability of semiconductors.
CO4	To know about various non-volatile memories
CO5	To learn the radiation hardening process and issues for memory.
CO6	To learn Memory MCM Testing and Reliability Issues

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	M	H	H	M	H			H	H	M	M
	CO2	H	H	M	H	M			M	M	H	H
	CO3	M	M	H	H	H			M	H	H	H
	CO4	M	M	H	M	H			H	M	H	H
	CO5	H	M	H	M	H			H	H	M	H
	CO6	M	H	M	H	H			M	M	H	H

3	Category	Professional Core (PC)
4	Approval	47th Meeting of Academic Council, Aug 2018

P18PEVD041	**NON – LINEAR SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital signal processing				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- The student understands Maximum Likelihood estimation, point and scale estimation.
- The student is familiar with binary and colour image processing basics.
- The student can handle median based operations.
- The student has knowledge about sorting operations.
- The student can explain various implementation technologies.

UNIT I LINEAR SIGNAL PROCESSING AND STATISTICAL PRELIMINARIES 9

Random Variables and Distributions – Estimation – Point Estimation – Maximum likelihood Estimators – M-Estimators – L-Estimators – R-Estimators – Scale Estimation - Noise Models.

UNIT II BINARY IMAGE AND COLOUR IMAGE PROCESSING 9

Introduction – Morphological Image Processing –Standard Binary morphological operations – Dilation and Erosion based operations. Introduction to colour image processing – Light and colour – Colour formation – Human perception of colour – Colour Model – the Chromaticity Diagram – Colour image Quantization – Histogram of a Colour image – Colour image Filtering – Pseudo-Colouring – colour image segmentation.

UNIT III INTRODUCTION TO NON LINEAR FILTERS 9

Nonlinear filters – Measures of robustness – Order Statistics Filters – Median filters and their characteristics – Impulse noise filtering by median filters – Recursive and weighted median filters –Decision based filters – Switched Median filters.

UNIT IV ALGORITHMS 9

Sorting and Selection Algorithm – Running Median Algorithm – Bitonic sort – Bubble sort and its variant – Shellsort – Quick sort – Bucket and Sample sort – Enumeration sort and Radix sort.

UNIT V ARCHITECTURE AND APPLICATIONS OF NONLINEAR FILTERS 9

Basic structure for order statistics filtering – Systolic array implementation – Wavefront array implementation – General nonlinear filter structure – Signal dependent noise filtering – Computational complexity of general nonlinear filter model – Nonlinear Edge Detection – Implementation of decision logics.

TOTAL :45 PERIODS

Text Books:

1. 1 Gonzalo R. Arce,"Nonlinear Signal Processing: A Statistical Approach", Wiley-Interscience, 2004.
2. S. K Mitra, "Nonlinear Image Processing ", Academic Press, 2000.

REFERENCES

1. Loannis Pitas, Anastasios N. Venetsanopoulos,"Nonlinear digital filters: principles and applications", Springer, 1990 – Technology & Engineering.

COURSE OUTCOMES (COs)	
CO1	Derive Maximum Likelihood criterion in the least square sense.
CO2	Define the rules and standards for binary
CO3	Describe different sorting algorithms.
CO4	Design simple median based filters.
CO5	Develop different architecture schemes for nonlinear filters.
CO6	Define the rules and standards for colour image processing

2.

	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	l
2	CO1		H				M						
	CO2	M			H	M				M			
	CO3		M									L	
	CO4	L							L				
	CO5			L	M			M			M		M
	CO6												
3	Category		Engg Sciences (ES)										
4	Approval		47th Meeting of Academic Council, Aug 2018										

P18PEVD042	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:Microwave Engineering				
	Course Designed by: – Department of Electronics & Communication Engineering				

Course Objectives:

- To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
- To understand EMI sources and its measurements.
- To understand the various techniques for electromagnetic compatibility

SYLLABUS

UNIT I EMI ENVIRNONMENT **6**

Sources of EMI, Conducted and radiated EMI, Transient EMI, EMI – EMC Definition and units of Parameters.

UNIT II EMI COUPLING, PRINCIPLES **9**

Conducted, Radiated and Transient coupling, Common impedance ground coupling radiation common mode and ground loop coupling, radiated differential mode coupling near Field, cable to cable Coupling, power mains and power supply coupling.

UNIT III EMI SPECIFICATIONS / STANDARDS / LIMITS 7

Units of specifications civilian standard, military standards.

UNIT IV EMI MEASUREMENTS 7

EMI test instruments / systems, EMI test / EMI shielded chamber, open area test site, TEM cell antennas, conductors sensors / injectors / couplers, military test method and procedures, calibration procedures.

UNIT V EMI CONTROL TECHNIQUES 7

Shielding, filtering, grounding, bonding, isolation transformation, transient suppressor, cable routing, signal control, component selection and mounting. EMC DESIGN OF PCB'S-PCB traces crosstalk, impedance control, power distribution decoupling, zoning, mother board design and propagation delay models.

Total Periods: 45 Hours

Textbooks:

1. Bernard Keiser, "Principles of EMC" ,Artech House, 3rd, 1986.
2. Henry W. Ott "Noise Techniques in electronics systems" Willey and sons, New York, 1998.
3. B.P Kodali, "Engineering EMC Principles, Measurements and technologies", IEEE Press, 1996.

REFERENCE BOOK

1. Christos christopoulos ,Principles and Techniques of Electromagnetic Compatibility, CRC Press, 2 edition (21 June 2007).

COURSE OUTCOMES (COs) **After successful completion of this course, the students should be able to**	
CO1	Real-world EMC design constraints and make appropriate tradeoffs to achieve the most cost-effective design that meets all requirements
CO2	Designing electronic systems that function without errors or problems related to electromagnetic compatibility
CO3	Diagnose and solve basic electromagnetic compatibility problems

CO4	To be able to apply Maxwell's equations for electromagnetic systems.
CO5	To able to design systems to mitigate the effects of Electromagnetic Interference.
CO6	To design systems with Electromagnetic compatibility

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			M	H	H	M
	CO2	M	H	M	H	M			M	M	H	H
	CO3	H	M	H	H	H			M	H	H	H
	CO4	H	M		M							
	CO5	H	M	H	M	H			H	H	M	H
	CO6	H	M	M	H	H			M	M		H
3	Category	Professional Core (PC)										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD043	**COMPUTER AIDED DESIGN OF VLSI CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite –VLSI DESIGN				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

To study various physical design methods in VLSI and To understand the concepts behind the VLSI design rules and routing techniques.

SYLLABUS

UNIT IINTRODUCTION TO VLSI 9

Introduction to VLSI Methodologies – VLSI Physical Design Automation – Design and Fabrication of VLSI Devices – Fabrication Process and its impact on Physical Design.

UNIT II DESIGN AUTOMATION TOOLS 9

A Quick Tour of VLSI Design Automation Tools – Data Structures and Basic Algorithms – Algorithms Graph Theory and Computational Complexity – Tractable and Intractable Problems.

UNIT III METHODS FOR OPTIMIZATION 9

General purpose methods for combinational optimization – partitioning – Floor Planning and Pin Assignment – Placement – Routing.

UNIT IV SIMULATION 9

Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT – V HIGH LEVEL SYNTHESIS 9

High level Synthesis - Hardware models - Internal representation - Allocation - assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

TEXT BOOK:

1.N.ASherwani, "Algorithms for VLSI Physical Design Automation", 1999.

REFERENCES BOOK:

1.S.H. Gerez, "Algorithms for VLSI Design Automation", 1998.

COURSE OUTCOMES (COs)	
CO1	To understand about algorithms and graph theory for the development of VLSI tools
CO2	To know the limitations and advantages of CAD tools by means of which they can be operated successfully**.**
CO3	To understand the concepts behind the VLSI design rules and routing techniques
CO4	To use the simulation techniques at various levels in VLSI design flow.

CO5	To understand the concepts of various algorithms used for floor planning placement and routing techniques
CO6	To understand the concepts of Design Automation Tools.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	H			H	H						
	CO2	H	H		H	H				M		M
	CO3	H	H		H	H				M		M
	CO4		M		M		H			M		
	CO5	M								H	M	
	CO6						L			H		M
3	Category											
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD051	**CMOS ANALOG VLSI**	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3
	Prerequisite – VLSI Design				

	Course Designed by – Dept. of Electronics and Communication Engineering.

OBJECTIVES

- To understand CMOS analog circuits design
- To simulate Analog circuits using H SPICE.
- . To learn noise modeling of CMOS analog circuits

UNIT I - ANALOG CMOS SUB-CIRCUITS 9

Introduction to analog design, Passive and active current mirrors, band-gap references, Switched Capacitor circuits - basic principles, sampling switches, switched capacitor integrator, switched capacitor amplifier, simulation of CMOS sub circuits using SPICE.

UNIT II - CMOS SINGLE STAGE AMPLIFIERS 9

Common-Source stage (with resistive load, diode connected load, currentsource load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascode stage. Frequency responses of CS stage, CD stage, CG stage, cascode stage, simulation of CMOS amplifiers using SPICE.

UNIT III - DIFFERENTIAL AMPLIFIER & OPERATIONAL AMPLIFIERS 9

Single-ended and differential operation, basic differential pair – qualitative and quantitative analyses, common-mode response, differential pair with MOS loads, Performance parameters of op-amp, one stage op-amp, two-stage CMOS op-amp, Gain boosting, slew rate, power supply rejection, Simulation of differential amplifiers using SPICE.

UNIT IV - OSCILLATORS 9

General considerations, Ring oscillators, LC oscillators – cross-coupled oscillators, Colpitts oscillator, One-port oscillator, and voltage controlled oscillators. Simulation of oscillators using SPICE.

UNIT V - NOISE CHARACTERISTICS 9

Statistical characteristics of noise, Types of noise - thermal noise, flicker noise, Representation of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise bandwidth.

TEXT BOOK:

1. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.

2. Gray, Meyer, Lewis, Hurst, “Analysis and design of Analog Integrated Circuits”, Willey International, 4th Edition, 2002.

REFERENCES:

1. Allen, Holberg, “CMOS analog circuit design”, Oxford University Press, 2nd Edition, 2012.

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of analog design and about analog sub circuits
CO2	To understand the operation of CMOS Amplifiers
CO3	To learn about differential amplifiers and its simulation
CO4	To gain knowledge about the operational amplifiers
CO5	To understand the baic concepts of oscillators its types and their simulation
CO6	To analyze the noise characteristics in analog 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	H	M			M	M	H	H
	CO2	H	H	M	M	H			M	H	M	H
	CO3	H	H	M	M						M	M
	CO4	H	H	H	H	M			M	H	M	H
	CO5	H	H	H	M	M			M	M		M
	CO6	M	M						M			
	Category	Professional Elective										
4	Approval	47th Meeting of Academic Council, Aug 2018										

P18PEVD052	**Algorithms and Architecture for signal processing ICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Digital signal processing				
	Course Designed by – Dept. of Electronics And Communication Engineering				

OBJECTIVES

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Auto-correlation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem–Finite Data records,Simulation of uniformly distributed/Gaussian distributed white noise – Simulation of Sine wave mixed with Additive White Gaussian Noise.

UNIT II SPECTRUM ESTIMATION 9

Bias and Consistency of estimators - Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method - Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion – Wiener filter - Discrete Wiener Hoff equations – Mean square error.

UNIT IV ADAPTIVE FILTERS 9

Recursive estimators - Kalman filter - Linear prediction – Forward prediction and Backward prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization -

Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS – Sliding window RLS - Simplified IIR LMS Adaptive filter.

TOTAL PERIODS: 45

TEXTBOOK:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
2. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.

REFERENCES:

1. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
4. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood
   Cliffs, NJ1988.

COURSE OUTCOMES (COs)	
CO1	Become Digital Signal Processor specialized engineer
CO2	DSP based System Developer
CO3	Explain various noise types, Yule-Walker algorithm, parametric and non-parametric methods, Wiener and Kalman filtering,
CO4	To learn LMS and RMS algorithms, Levinson Durbin algorithm, adaptive noise cancellation and adaptive echo cancellation,.
CO5	To learn more of speed verses convergence issues, channel equalization, sampling rate change, subband coding and wavelet transform.
CO6	Calculate mean, variance, auto-correlation and PSD for WSS stochastic processes, and derive prediction error criterion, Wiener-Hoff equations, Parseval'stheorem,W-K theorem and normal equations.
	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	l
2	CO1					H							
	CO2	M	L						L	M			
	CO3				H		M				L		L
	CO4	M		H		L		M				M	
	CO5		H		M								
	CO6												
3	Category		Engg Sciences (ES)										
4	Approval		47th Meeting of Academic Council, Aug 2018										

		L	T	P	C
P18PEVD053	**INTRODUCTION TO MEMS SYSTEM DESIGN**				
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Electronics & Communication Engineering				

OBJECTIVES:

The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components. And to introduce the students various opportunities in the emerging field of MEMS.

SYLLABUS

UNIT-I INTRODUCTION TO MEMS AND MICRO FABRICATION 9

History of MEMS Development, Characteristics of MEMS-miniaturization - micro electronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process-

silicon based MEMS processes- new material and fabrication processing- points of consideration for processing.

UNIT-II ELECTRICAL AND MECHANICAL PROPERTIES OF MEMS MATERIALS 9

Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- deflection of beam-longitudinal stain under pure bending spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

UNIT-III SENSING AND ACTUATION 9

Electrostatic sensing and actuation-parallel plate capacitor – Application-Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations-thermal sensors-Actuators- Applications- Inertial, Flow and Infrared sensors.Piezo-resistive sensors-piezo-resistive sensor material- stress in flexural cantilever and membrane Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF –ZnO Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation- Micro magnetic actuation principle- deposition of magnetic materials-Design and fabrication of magnetic coil.

UNIT-IV BULK AND SURFACE MICROMACHINING 9

Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micromachining process- structural and sacrificial material, stiction and antistiction methods, Foundry process.

UNIT- V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS- polymide-SU-8 liquid crystal polymer(LCP)-PDMS-PMMA-Parylene-Flurocorbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-mirrors-Actuation for active optical MEMS.

TEXT BOOK:

1.Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.

REFERENCES BOOKS:

1.GaberielM.Rebiz, “RF MEMS Theory,Design and Technology”, John Wiley & Sons,2003

2.CharlesP.Poole, Frank J.Owens, “Introduction to nanotechnology” John Wiley & sons, 2003.

3.JulianW.Gardner, Vijay K Varadhan, “Microsensors, MEMS and Smart devices”, John Wiley & sons, 2001

COURSE OUTCOMES (COs)	
CO1	Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
CO2	Understand the rudiments of Micro fabrication techniques
CO3	Identify and understand the various sensors and actutators
CO4	Be familiar with the important concepts applicable to MEMS, their fabrication
CO5	Applications of MEMS to disciplines beyond Electrical and Mechanical engineering
CO6	Be fluent with the design, analysis and testing of MEMS & apply the MEMS for different applications.

Mapping of Course Outcomes with Student Outcomes (SOs)

(S/M/L 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	M	M	H	H	H					M	
	CO2		M	M	H					M		
	CO3		M	H	H					M		
	CO4	M		M	H		H			M		H
	CO5	H	M	H	H		M			M		
	CO6	M	M	H	H		H			H	M	H
3	Category	Professional Electives										
4	Approval	47th Meeting of Academic Council, Aug 2018										

OPEN ELECTIVES

P18OEVD001	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Module 1 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 9 Hours

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module 4 **9 Hours**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module 5 **5 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module 6 **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

18OEPSVD02 INDUSTRIAL SAFETY

P18OEMA002	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

Module 1 **9 Hours**

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.

Module 2 **9 Hours**

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.

Module 3 **9 Hours**

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

Module 4 **9 Hours**

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.

Module 5 **9 Hours**

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

Total No. of Periods: 45

References Books:

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.

18OEPSVD03 OPERATIONS RESEARCH

P18OEME003	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

Module 1 **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module 2 **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3 **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 4 **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5 **9 Hours**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

18OEPSVD04 COST MANAGEMENT OF ENGINEERING PROJECTS

P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module 1: 9 Hours

Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module 2: 10 Hours

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module 3:10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 4: 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

18OEPSVD05 COMPOSITE MATERIALS

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineeri				

Module 1 **9 Hours**

Introduction

Definition – Classification and characteristics of Composite materials.Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2 **9 Hours**

Reinforcements

Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers.Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module 3 **9 Hours**

Manufacturing of Metal Matrix Composites

Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module 4 **9 Hours**

Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module 5 **9 Hours**

Strength

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.

Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

18OEPSVD06 WASTE TO ENERGY

P18OEEE005	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electro Engineering				

Module 1 **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2 **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

	Course Designed by – Department of Electrical & Electronics Engineering

Module 3 **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4 **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5 **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 & AUDIT 2

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title

SYLLABUS:

UNIT I: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness.

UNIT II: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

UNIT III: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT IV: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

UNIT V: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I: **4 Hours**

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II: **4 Hours**

Repercussions Of Disasters And Hazards: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: **4 Hours**

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV: **4 Hours**

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **4 Hours**

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI: **4 Hours**

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNIC KNOWLEDGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

To get a working knowledge in illustrious Sanskrit, the scientific language in the world.

Learning of Sanskrit to improve brain functioning.

Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.

The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III: **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-BhartiPublication,New Delhi

2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

Understanding basic Sanskrit language

Ancient Sanskrit literature about science & technology can be understood.

Being a logical language will help to develop logic in students

P18ACBA004	**AUDIT : VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to

Understand value of education and self- development.

Imbibe good values in students.

Let the should know about the importance of character.

SYLLABUS:

UNIT I: **4 Hours**

Values and self-development –Social values and individualattitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.Valuejudgements

UNIT II: **6 Hours**

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, CleanlinessHonesty, Humanity.Power of faith, National Unity.Patriotism. Love for nature, Discipline.

UNIT III: **6 Hours**

Personality and Behavior Development - Soul and Scientificattitude.Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.HappinessVs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

UNIT IV: **6 Hours**

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality ,Non violence ,Humility, Role of Women.All religions and same message.Mind your Mind ,Self-control.Honesty, Studying effectively.

Suggested reading

Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	**AUDIT: CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS:

UNIT I: **4 Hours**

History of Making of the Indian Constitution: HistoryDrafting Committee, (Composition & Working)

UNIT II: **4 Hours**

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III: **4 Hours**

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**

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of MinistersJudiciary, 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, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

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.

Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	**AUDIT : PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I: 4 Hours

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and Searching.

UNIT II: 2 Hours

Thematic overview:Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

UNIT III: 4 Hours

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: 4 Hours

Professional development:: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V: 2 Hours

Research gaps and future directions: Researchdesign,Contexts,Pedagogy

Teacher education**,**Curriculum and assessment,Dissemination and research impact.

Suggested Reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.

- ✓ Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

- ✓ Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

- ✓ Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.

- ✓ Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

- ✓ www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- ✓ What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

  What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

  How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT: STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0

	Prerequisite – NIL
	Course Designed by – AICTE

Course Objectives:

To achieve overall health of body and mind

To overcome stress

SYLLABUS:

UNIT I: **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II: **8 Hours**

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

Develop healthy mind in a healthy body thus improving social health also

Improve efficiency

P18ACBA008	**AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

To learn to achieve the highest goal happily

To become a person with stable mind, pleasing personality and determination

To awaken wisdom in students

SYLLABUS:

UNIT I: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (dont's)

Verses- 71,73,75,78 (do's)

UNIT II:

Approach to day to day work and duties.**8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35

Chapter 18-Verses 45, 46, 48.

UNIT III: **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested Reading

"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students

CURRICULUM AND SYLLABUS
(R2018)

(Applicable to the batches admitted from July 2018)

M.Tech – Power Electronics & Drives
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCPD101	PC	Electric Drives System	3	3	0	0	3
2	P18PCPD102	PC	Modeling and Analysis of Electrical Machines	3	3	0	0	3
3		PE	Professional Elective - 1	3	3	0	0	3
4		PE	Professional Elective - 2	3	3	0	0	3
5	P18PRPD101	PR	Research Methodology for Electrical Engineers and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
8	P18PCPD1L1	PC	Electrical Drives Laboratory	4	0	0	4	2
9	P18PCPD1L2	PC	Modeling and Analysis of Electrical Machines Laboratory	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCPD201	PC	Power Electronic Converters	3	3	0	0	3
2	P18PCPD202	PC	Digital Control of Power Electronic and Drive Systems	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
6		AC	Audit II	2	2	0	0	0
PRACTICAL								
7	P18PCPD2L1	PC	Power Electronics Laboratory	4	0	0	4	2
8	P18PCPD2L2	PC	Digital Control of Power Electronic and Drive Laboratory	4	0	0	4	2
9	P18PRPD2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRPD3P2	PR	Phase – I Dissertation	20	0	0	20	10
			Total	26	6	0	20	16

SEMESTER IV								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRPD4P3	PR	Phase-II Dissertation	32	0	0	32	16
			Total	32	0	0	32	16

TOTAL CREDITS FOR THE PROGRAM = 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE - 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPD011	PE	Advanced Power Electronic Circuits	3	3	0	0	3
2	P18PEPD012	PE	Optimal and Adaptive Control	3	3	0	0	3
3	P18PEPD013	PE	Power Quality	3	3	0	0	3
4	P18PEPD014	PE	Applied Mathematics	3	3	0	0	3

PROFESSIONAL ELECTIVE - 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPD021	PE	Static VAR Controllers and Harmonic Filtering	3	3	0	0	3
2	P18PEPD022	PE	Pulse Width Modulation For PE Converters	3	3	0	0	3
3	P18PEPD023	PE	Power Semiconductor Devices & Modeling	3	3	0	0	3
4	P18PEPD024	PE	Special Electrical Machines and Controllers	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPD031	PE	Switched Mode and Resonant Converters	3	3	0	0	3
2	P18PEPD032	PE	Industrial Load Modeling and Control	3	3	0	0	3
3	P18PEPD033	PE	Advanced Digital Signal Processing	3	3	0	0	3
4	P18PEPD034	PE	Solid State AC Drives	3	3	0	0	3

PROFESSIONAL ELECTIVE - 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPD041	PE	Advanced Microcontroller based Power Electronic Systems	3	3	0	0	3
2	P18PEPD042	PE	Distributed Generation and Micro Grid	3	3	0	0	3
3	P18PEPD043	PE	Smart Grids	3	3	0	0	3
4	P18PEPD044	PE	Solid State DC Drives	3	3	0	0	3

PROFESSIONAL ELECTIVE - 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPD051	PE	SCADA Systems and Applications	3	3	0	0	3
2	P18PEPD052	PE	FACTS and Custom Power Devices	3	3	0	0	3
3	P18PEPD053	PE	HVDC	3	3	0	0	3
4	P18PEPD054	PE	Design Of Intelligent Controllers	3	3	0	0	3

OPEN ELECTIVE

Sub. Code	**Subject Name**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
P18OEBA001	Business Analytics	3	3	0	0	3
P18OEMA002	Operations Research	3	3	0	0	3
P18OEME003	Industrial Safety	3	3	0	0	3
P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
P18OEME005	Composite Materials	3	3	0	0	3
P18OEEE006	Waste to Energy	3	3	0	0	3

AUDIT COURSES I &II

SL. NO.	CODE NO.	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	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		
1	Professional Core (PC)	10	10			20	29.41
2	Program Electives (PE)	6	6	3		15	22.05
3	Open Electives (OE)			3		3	4.41
4	Project+ Research methodology+seminar (PR)	2	2	10	16	30	44.12
5	Audit Course(AC)	0	0				
	Total Credit	18	18	16	16	68	
	Total Contact Hour	24	26	26	32	108	

P18PCPD101 ELECTRICAL DRIVES SYSTEM

P18PCPD101	**ELECTRICAL DRIVES SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To gain fundamental knowledge of Electrical drives and its applications

SYLLABUS

Module I DC motor characteristics 6hours

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Module II Chopper fed DC drive 6 hours

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Module III Multi-quadrant DC drive 6 hours

Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Module IV Closed-loop control of DC Drive 6 hours

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Module V Induction motor characteristics 7 hours

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Module VI Scalar control or constant V/f control of induction motor 8 hours

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Module VII Control of slip ring induction motor 6 hours

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip

ring motor, slip power recovery.

References:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.

Text Book:

1. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
2. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

COURSE OUTCOMES (COs)	
CO1	To Understand the characteristics of dc motors under various operating conditions.
CO2	Understand the principles of Chopper fed DC drive
CO3	Understand the single-quadrant, two-quadrant and four-quadrant choppers
CO4	Student will gain knowledge regarding Closed-loop control of DC Drive and structure, inner current loop and outer speed loop, dynamic model
CO5	Student will gain knowledge regarding Induction motor characteristics
CO6	Student will gain knowledge regarding scalar control or constant V/f control of induction motor
CO7	Student will gain knowledge regarding Control of slip ring induction motor

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	PSO1	PSO2
2	CO1	H	L	M	H	H	H	L
	CO2	H	L	L	H	H	H	L
	CO3	H	L	M	H	H	H	L
	CO4	H	L	M	H	H	H	L
	CO5	H	L	L	H	H	H	L
	CO6	H	L	M	H	H	H	L
	CO7	H	L	L	H	H	H	L
3	Category	Professional Core Course (PCC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PCPD101 ELECTRICAL DRIVES SYSTEM	H	L	M

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

		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
	P18PCPD101 ELECTRICAL DRIVES SYSTEM	H	L	M	H	H	H	L

P18PCPD102	MODELING AND ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To understand the operation of an electrical machine and to develop mathematical model of AC & DC machines and study the analysis of Switch Reluctance Motors. Brushless D.C. Motor

SYLLABUS

Module I **9 hours**

Principles of Electromagnetic Energy Conversion. General expression of stored magnetic energy. Co-energy and force/torque, example using single and doubly excited system.

Module II **9 hours**

Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

Module III **9 hours**

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form - Application of reference frame theory to three phase symmetrical induction and synchronous machines-Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.

Module IV **9 hours**

Determination of Synchronous machine dynamic equivalent circuit parameters -Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

Module V **9 hours**

Special Machines - Permanent magnet synchronous machine,Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines, Construction and operating principle, Dynamic modelling and self-controlled operation.

Analysis of Switch Reluctance Motors. Brushless D.C. Motor for space Applications -Recent trends.

Suggested reading

1. Charles Kingsle,Jr., A.E. Fitzgerald, Stephen D.Umans, “Electric Machinery”, Tata Mcgraw Hill
2. R. Krishnan, “Electric Motor & Drives: Modeling, Analysis and Control”, Prentice Hall of India
3. Miller, T.J.E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press
4. P.C.Krause “Analysis of Electric Machine” Wiley IEEE Press 3rd Edition

COURSE OUTCOMES (COs)	
CO1	To gain knowledge about the Principles of Electromagnetic Energy Conversion.
CO2	Able to understand the basic concepts of Rotating Machines and perform mathematical analysis
CO3	Able to understand the modeling of three phase symmetrical induction machine and salient pole synchronous machine
CO4	To analyze and dynamic modeling of two phase asymmetrical induction
CO5	To analyze and modeling of Special Machines

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	PSO1	PSO2
2	CO1	H		H			M	--
	CO2	H				M	M	--
	CO3		M				M	--
	CO4			H		H	M	--
	CO5				H		M	--
3	Category	Professional core (PC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PCPD102 MODELING AND ANALYSIS OF ELECTRICAL MACHINES	H	L	--

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPD102 MODELING AND ANALYSIS OF ELECTRICAL MACHINES**	H	H	L			M	-

P18PRPD101 RESEARCH METHODOLOGYAND IPR

P18PRPD101	**RESEARCH METHODOLOGY FOR ELECTRICAL ENGINEERS AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	0	0	2
	Prerequisite – Professional ethics				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Student will understand research problem formulation and Analyze research related information and details of IPR

SYLLABUS

Module I Introduction 9 hours

Meaning of research problem, Sources of research problem, CriteriaCharacteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Module II Research Methodology and Analysis 6 hours

Effective literature studies approaches, analysis Plagiarism, and Research ethics.

Module III Report writing 6 hours

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Module IV Nature of Intellectual Property 9 hours

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Module V Patent Rights 6 hours

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Module VI New Developments in IPR 9 hours

New Developments in IPR: Administration of Patent System. Newdevelopments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested reading

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.

- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To understand the Approaches of investigation of solutions for research problem
CO2	To analysis Plagiarism
CO3	To able to understand the Effective technical writing
CO4	To gain knowledge of Nature of Intellectual Property
CO5	Understand the concept of Patent Rights
CO6	To gain knowledge in New Developments in IPR

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	PSO1	PSO2
2	CO1	M	H	H		H	H	
	CO2	M	H	H		H		
	CO3	M				M		H
	CO4	M	H	L		H		M
	CO5	M		M		M	L	L
	CO6	M				L		H
3	Category	PROFESSIONAL RESEARCH(PR)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PRPD101 RESEARCH METHODOLOGYAND IPR	H	H	H

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PRPD101Research Methodology**	H	H	H		H	H	H

PRACTICAL

P18PCPD1L1 ELECTRICAL DRIVES LABORATORY

P18PCPD1L1	**ELECTRICAL DRIVES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Electrical Drives System				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To learn through experiments of about the AC-DC control drives.

List of experiments:

1. Study of Thyristor controlled D.C Drive.
2. Study of Chopper Fed DC Motor.
3. Study of A.C single phase motor speed control using TRIAC.
4. PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software.
5. VSI/CSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software.
6. Study of V/f control operation of three phase induction motor.
7. Study of permanent magnet synchronous motor drive fed by PWM inverter using software.
8. Regenerative/ Dynamic breaking operation for DC motor study using software.
9. Regenerative/ Dynamic breaking operation for AC motor study using software.
10. PC/PLC based AC/DC motor control operation.

Suggested Reading:

- Department Lab Manual

COURSE OUTCOMES (COs)	
CO1	To Study about the Thyristor controlled D.C Drive.
CO2	To Study about the Chopper Fed DC Motor.
CO3	To Study about the PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software.
CO4	To study about the Regenerative/ Dynamic breaking operation for AC and DC motor study using software.
CO5	To study about the PC/PLC based AC/DC motor control operation.

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	PSO1	PSO2
2	CO1		H			H	H	M
	CO2						H	M
	CO3		M	M		H	H	M
	CO4		H			H	H	M
	CO5		H			H	H	M
3	Category	Professional Core Course (PCC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPD1L1 ELECTRICAL DRIVES LABORATORY	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
	COURSE	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	**P18PCPD1L1ELECTRICAL DRIVES LABORATORY**		M	M		H	H	M

P18PCPD1L2MODELING AND ANALYSIS OF ELECTRICAL MACHINES LABORATORY

P18PCPD1L2	**MODELING AND ANALYSIS OF ELECTRIC MACHINES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Electrical Machines Laboratory				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To learn by conducting experiments about operation and characteristics of DC and AC machines.

List of Experiments:

1. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics.
2. Field Test on dc series machines.
3. Speed control of dc shunt motor by armature and field control.
4. Swinburne's Test on dc motor.
5. Retardation test on dc shunt motor.
6. Regenerative test on dc shunt machines.
7. Load test on three phase induction motor
8. No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) Circle diagram. Determination of performance parameters at different load conditions from (i) and (ii).
9. Load test on induction generator.
10. Load test on single phase induction motor to draw output versus torque, current, power and Efficiency characteristics.
11. Conduct suitable tests to draw the equivalent circuit of single phase induction motor and Determine performance parameters.
12. Conduct an experiment to draw V curve of synchronous motor at no load and load Conditions.

CO1	To analyze about the load test of DC motors
CO2	To learn about the equivalent circuit of three phase induction motor
CO3	To learn the load test of induction generator.
CO4	To learn about the load test of the induction motor and its characteristics
CO5	Conduct an experiment to draw V curve of synchronous motor at no load and load 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1		H			H	H	M
	CO2	H					H	M
	CO3		M	M		H	H	M
	CO4		H			H	H	M
	CO5		H			H	H	M
3	Category	Professional Core Course (PCC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PCPD1L2 MODELING AND ANALYSIS OF ELECTRICAL MACHINES LABORATORY	H	H	M

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

	COURSE	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	**P18PCPD1L2 MODELING AND ANALYSIS OF ELECTRICAL MACHINES LABORATORY**		M	M		H	H	M

SEMESTER II

P18PCPD201	POWER ELECTRONIC CONVERTERS	L	T	P	C
	Total Contact Hours – 45	0	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Students will be able to:

1. To impart knowledge, analyze and to design the power Electronic AC-DC converter, Phase Controlled , Converters, Cycloconverter ,Dual Bridge converters and Reactive Power Control.

SYLLABUS

MODULE I Analysis of AC – DC Converter 8 hours

Circuits and operating principles: Analysis of Single phase and three phase controlled rectifiers with RLE loads - Input line current harmonics and power factor– Fourier analysis of controlled rectifiers - Dual converters.

MODULE II Performance Characteristics of Phase Controlled Converters 8hours

Performance parameters: Dc voltage ratio – input displacement angle –displacement factor - power factor – current distortion factor- Harmonic content of DC terminal voltage and input current - THD of Two quadrant converters and one quadrant converters - reduction of reactive loading of the supply by the Two quadrant converter by means of consecutive firing angle control.

MODULE III Analysis of Phase Controlled Cycloconverter 8 hours

Symmetrical - open delta - Ring connected cycloconverter circuits –Harmonic distortion in the output voltage – General Expression for Three pulse waveform for an arbitrary firing angle control method - Harmonic series of three and six pulsecycloconverters – cosine wave control method – Firing pulse generation: Functional schemes – End stop control : reference voltage - clamp method – pulse isolating output stage.

MODULE IV Analysis of AC – AC Converters 7 hours

Analysis of Single-phase and Three phase AC Voltage Controllers- Matrix converter - Bi-directional switch topologies, Modulation techniques for matrix converters, Concept of Direct AC-AC frequency Converter.

MODULE V Front End Rectifiers with Real and Reactive Power Control 7hours

Overview of Power Factor Correction Approaches - Unity power factor rectifiers -Resistor emulation principle –mathematical modeling – control schemes- Design of feedback compensators -front end rectifiers with real and reactive power control– Phase shifter.

MODULE VI Dual Active Bridge Converter 7 hours

Dual active bridge converter – circuit configuration – steady state analysis – steady state model of DC-DC DAB Converters - Steady-State Model for AC-AC DAB Converters - soft switching analysis –

DAB for Solid state transformer.

TEXT BOOKS:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", Pearson Education India, 2003

2. Eric Mon Masson, Power Electronic Converters PWM Strategies and Current Control Techniques, John Wiley & Sons, Inc, © ISTE Ltd 2011.

REFERENCES:

1. Ned Mohan, Tore M. Undeland. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., 2003.

2. M.D.Singh, "PowerElectronics"Tata McGraw-Hill Education, 07-Jul-2008.

3. D.M.Mitchell, DC-DC Switching Regulator Analysis McGraw-Hill Ryerson, Limited, 1988.

4. "Power Factor Correction (PFC) Handbook", HBD853/D Rev. 5, Apr–2014.

COURSE OUTCOMES (COs)	
CO1	To analyze of Single phase and three phase controlled rectifiers
CO2	To study of performance characteristics and parameters of phase controlled Converters
CO3	Analysis of Phase Controlled Cycloconverter
CO4	To analyze of AC to AC Converters
CO5	Provides a comprehensive overview of PFC circuits and details of operation and design considerations for commonly used PFC circuits.
CO6	Able to learn more about advanced Duel Bridge power electronics converters

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	PSO1	PSO2
2 `	CO1	H	H	H		M	H	L
	CO2	H	M	M			H	
	CO3	H	H	H		M	H	L
	CO4	H	H	H		M	H	L
	CO5	H	H	H		M	H	L
	CO6	H	H	H		M	H	L
3	Category	Professional Core Course (PCC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPD201 POWER ELECTRONIC CONVERTERS	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPD201 POWER ELECTRONIC CONVERTERS**	H	H	H		M	H	L

P18PCPD202	DIGITAL CONTROL OF POWER ELECTRONICS AND DRIVE SYSTEMS	L	T	P	C
	Total Contact Hours – 45	0	0	0	3
	Prerequisite – Electric Drive System				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To gain fundamental knowledge of Digital Control of Power Electronics and Drive systems

SYLLABUS

Module I Review of numerical methods 6 hours

Review of numerical methods. Application of numerical methods to solve transients in D.C.Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits

Module II Modelling of diode in simulation 8 hours

Modelling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with AC supply.Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation. Application of numerical methods to R, L, C circuits with power electronic switches. Simulation of gate/base drive circuits, simulation of snubber circuits.

Module III State space modelling and simulation of linear systems 7 hours

State space modelling and simulation of linear systems. Introduction to electrical machine modelling: induction, DC, and synchronous machines, simulation of basic electric drives, stability aspects.

Module IV Simulation of power electronics and drive system 8 hours

Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers. Converters with self-commutated devices- simulation of power factor correction schemes.

Module V Simulation DC motor drives 8 hours

Simulation of converter fed DC motor drives. Simulation of thyristors choppers with voltage Current and load commutation schemes. Simulation of chopper fed DC motor.

Module VI Simulation of inverters 8 hours

Simulation of single and three phase inverters with thyristors and self- commutated devices.
Space vector representation. Pulse-width modulation methods for voltage control. Waveform control. Simulation of inverter fed induction motor drives.

Text Book

1. Simulink Reference Manual, Math works, USA
2. Digital Power Electronics and Applications, Fang Lin Luo Hong Ye Muhammad Rashid, Elsevier Academic Press. 2005.
3. Digital Control in Power Electronics, 2nd Edition,Simone Buso and Paolo Mattavelli,Synthesis Lectures on Power Electronics, May 2015, Vol. 5, No. 1 , Pages 1-229,Morgan & Clay Pool Publishers

COURSE OUTCOMES (COs)	
CO1	To understand application of numerical methods to solve transients in AC circuits
CO2	To understand Modeling of SCR, TRIAC, IGBT and Power Transistors in simulation
CO3	To gain knowledge of state space modelling and simulation of linear systems.
CO4	To provide knowledge of simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers
CO5	The candidate will be able to simulate converter fed DC motor drives
CO6	To understand the single and three phase inverters with thyristors and self- commutated 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		M	H	L
	CO2	H	M	M			H	
	CO3	H	H	H		M	H	L
	CO4	H	H	H		M	H	L
	CO5	H	H	H		M	H	L
	CO6	H	H	H		M	H	L
3	Category	Professional Core Course (PC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPD202 Digital Control of Power Electronics and Drive systems	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
	COURSE	PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	**P18PCPD202 Digital Control of Power Electronics and Drive systems**	H	H	H		M	H	L

P18PCPD2L1	POWER ELECTRONICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	4	2
	Prerequisite -Power Electronics Converters				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To gain conceptual knowledge to design and analyze Power Electronic devices.

SYLLABUS:

1. To study V-I characteristics of SCR and measure latching and holding currents.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectifier with
   (i) Resistive load
   (ii) Inductive load with and without freewheeling diode.
4. To study single phase
   (i) Fully controlled
   (ii) Half controlled bridge rectifiers with resistive and inductive loads.
5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.
6. To study single-phase ac voltage regulator with resistive and inductiveloads.
7. To study single phase cyclo-converter.
8. To study triggering of

(i) IGBT
(ii) MOSFET
(iii) Power transistor.

9. To study operation of IGBT/MOSFET chopper circuit.
10. To study MOSFET/IGBT based single-phase series-resonant inverter.
11. To study MOSFET/IGBT based single-phase bridge inverter.

COURSE OUTCOMES (COs)	
CO1	To experiment and analyze the characteristics of SCR and UJT
CO2	To experiment and analyze half controlled rectifier
CO3	To experiment and analyze full controlled rectifier
CO4	To experiment and analyze IGBT , MOSFET and Power transistor
CO5	To experiment and analyze MOSFET/IGBT based single-phase bridge inverter.

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

1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		M		H
	CO2	H	H	H		M		H
	CO3	H	H	H		M		H
	CO4	H	H	H		M		H
	CO5	H	H	H		M		H
3	Category	Program core Course (PC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPD2L1 **POWER ELECTRONICS LABORATORY**	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPD2L1** **POWER ELECTRONICS LABORATORY**	H	H	H		M		H

		L	T	P	C
P18PCPD2L2	**DIGITAL CONTROL OF POWER ELECTRONIC AN DRIVE LABORATORY**				
	Total Contact Hours – 30	0	0	4	2
	Prerequisite - Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To understand the **Digital Control of Power Electronic and Drives by doing experiments.**

List of Experiments

1. To design, and simulate digital controlled rectifiers
2. To design and simulate digital controlled inverters
3. To design and simulate AC-DC-AC Converter
4. To design and simulate Buck Converter
5. To design and simulate Boost Converter
6. To design and simulate Three-Phase Harmonic Filter
7. Case Study – Single six Pulse HVDC Transmission System
8. Case Study - Single twelve Pulse HVDC Transmission System

COURSE OUTCOMES (COs)	
CO1	To Understand the design and simulation of controlled rectifiers and Inverters
CO2	To Understand the design and simulation of AC-DC-AC Converter
CO3	To design and simulate Buck and Boost Converter
CO4	To design and simulate Three-Phase Harmonic Filter
CO5	To analyze the Case Study of Single six and twelve Pulse HVDC 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M	M	M	H	M	H	M
	CO2	M	M	M	H	M	H	M
	CO3		M	H	H	H	H	M
	CO4		M	H	H	H	H	M
	CO5	M	M	M	H	M	H	M
3	Category	Professional Core Course (PC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PCPD2L2 **DIGITAL CONTROL OF POWER ELECTRONIC AND DRIVE LABORATORY**	M	M	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPD2L2** **DIGITAL CONTROL OF POWER ELECTRONIC AND DRIVE LABORATORY**	M	M	M	H	M	H	M

P18PRPD2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

The student shall be capable of identify design, fabricate mini projects of power electronic Components

COURSE OUTCOMES (COs)	
CO1	Understand and analyze the basic schemes and components of Power Electronic System.
CO2	To understand and analyze the design concepts of Power Electronic Components
CO3	To understand the applications of Power Electronic Components.
CO4	To design and implement mini projects related to Power Electronic components

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	PSO1	PSO2
2 `	CO1		H	H	M	M	M	M
	CO2		H	H	M	M	M	M
	CO3		H	H	M	M	M	M
	CO4		H	H	M	M	M	M
3	Category	Project(PR)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PRPD2P1MINI PROJECT WITH SEMINAR	H	H	

Mapping of Course with Student outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PRPD2P1MINI PROJECT WITH SEMINAR**		H	H	M	M	M	M

SEMESTER III

	PHASE-I DISSERTATION	L	T	P	C
P18PRPD3P2	Phase-I Dissertation	0	0	20	10

SEMESTER IV

	PHASE-II DISSERTATION	L	T	P	C
P18PRPD4P3	Phase-II Dissertation	0	0	32	16

PROFESSIONAL ELECTIVE - I

P18PEPD011 ADVANCED POWER ELECTRONIC CIRCUITS

	ADVANCED POWER ELECTRONIC CIRCUITS	L	T	P	C
P18PEPD011	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

Objectives: Students will be able to learn the ability to understand working various Advanced Power Electronic Circuits and Soft switching and resonant converters.

Module I DC-DC converters 9 Hours

Analysis and detailed design of buck, boost, buck-boost, Cuk and SEPIC converters, Analysis and detailed design of isolated dc-dc converters including forward, fly back, push-pull, full bridge and dual-active bridge topologies, Continuous and discontinuous current modes of operation, Linearized small-signal average models of dc-dc converters, Voltage mode and current mode control design methods, Design of magnetics for dc-dc converters.

Module II Power management and Digital control 9 Hours

Switching regulators for modern processors – multi-phase voltage regulators, design for high dynamic performance, switched capacitor converters, features of power management integrated circuits, Review of digital control systems, Digital control techniques for power converters; modeling and simulation, Design examples of multi-phase VR, and PWM dc-ac converter.

Module III AC-DC PWM rectifiers and DC-AC PWM inverters 9 Hours

Power quality issues, Boost and fly back converter based power factor correction circuits (PFC), Design and control of PFC Full bridge bi-directional PWM rectifiers. Voltage source inverters - topology and PWM techniques, Models of single phase and three phase inverters and control methods, C synthesis Three-phase PWM techniques.

Module IV Grid interface of renewable energy resources 9 Hours

Power converters and control for interfacing solar and wind energy to grid, Distributed generation and impact on power distribution systems, Micro grids and smart grid technologies using power electronic converters.

Module V Soft switching and resonant converters 9 Hours

Concept of ZVS and ZCS, Zero voltage transition converters, resonant converters and applications in lighting. Practical issues in power electronic converters - Selection criteria for diodes, MOSFETs and

IGBTs; gate drive circuits, Thermal management, EMI and layout issues

Text/References:

1. Rashid "Power Electronics" Prentice Hall India 2007.
2. G.K.Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.
3. Dewan&Straughen "Power Semiconductor Circuits" John Wiley &Sons. 1975.
4. G.K. Dubey& C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993
5. Cyril W Lander "Power Electronics" McGraw Hill., 2005.
6. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia).2007
7. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company.2001

CO1	To Understand and analysis and detailed design of isolated dc-dc converters
CO2	To Understand the power management integrated circuits, review of digital control systems and Digital control techniques for power converters
CO3	To Understand design and control of PFC Full bridge bi-directional PWM rectifiers. Voltage source inverters - topology and PWM techniques,
CO4	To Understand the Power converters and control for interfacing solar and wind energy to grid
CO5	To know the Concept of ZVS and ZCS, Zero voltage transition converters, resonant converters and applications
CO6	To know more about Soft switching and resonant converters.

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	PSO1	PSO2
2	CO1	M	M	M	L	L	M	L
	CO2	M	H	H	L	L	L	M
	CO3	M	M	M	L	M	L	L
	CO4	H	H	L		L	M	M
	CO5	M	M	M	L	M	L	L
	CO6		H	H		L	-	H
3	Category	Professional Elective Course (PE)						
4	Approval	47thMeeting of Academic Council						

COURSE	PEO1	PEO2	PEO3
P18PEPD011ADVANCED POWER ELECTRONIC CIRCUITS	H	M	

Mapping of Course with Program outcomes (POs)

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD011 ADVANCED POWER ELECTRONIC CIRCUITS**	M	H	M	M	H	M	L

P18PEPD012 OPTIMAL AND ADAPTIVE CONTROL

P18PEPD012	**OPTIMAL AND ADAPTIVE CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – control system				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To know about the operation of adaptive control strategies various Optimal control problem

SYLLABUS

Module I Analysis of optimal control 9 Hours

Optimal control problem – fundamental concepts and theorems of calculus, of variations–Euler - Language equation and external of functional.

Module II Optimal control system 7Hours

Variational approach to solving optimal control problems, Hamiltonian and different boundary conditions for optimal control problem.

Module III Linear regulator 9 Hours

Linear regulator problem - Pontryagin's minimum principle.

Module IV Dynamic programming 6 Hours

Dynamic programming - Principle of optimality and its application to Optimal control problem.

Module V Adaptive system 6Hours

Hamilton-Jacobi-Bellman equation - model reference (MRAS) - Design hypothesis**.**

Module VI Design of adaptive control 8Hours

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model followingcontrol.

Suggested reading

1. Donald E. Kirk, "Optimal Control Theory, An introduction", Prentice Hall Inc., 2004
2. A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977
3. HSU and Meyer , "Modern Control, Principles and Applications", McGraw Hill, 1968
4. Yoan D. Landu, "Adaptive Control (Model Reference Approach)", Marcel Dekker. 1981
5. K.K.D.Young, "Design of Variable Structure Model Following Control Systems", IEEE Transactions on Automatic Control, Vol. 23, pp 1079-1085, 1978.

COURSE OUTCOMES (COs)	
CO1	To study fundamental concepts of Optimal control problem
CO2	To learn about the Optimal control system.
CO3	To learn about the linear regulator problem.
CO4	To study Dynamic programming and the application of optimal control problem
CO5	To study the model reference adaptive systems
CO6	To study about the design and simulation of variable structure adaptive model following 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M		H	M	H	H	M
	CO2	M		H	M	H	H	M
	CO3	M		H	M	H	H	M
	CO4	M		H	M	H	H	M
	CO5	M		H	M	H	H	M
	CO6	M		H	M	H	H	M
3	Category	Professional Elective Course (PE)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD012 OPTIMAL AND ADAPTIVE CONTROL	H	M	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
	P18PEPD012OPTIMAL AND ADAPTIVE CONTROL	M		H	M	H	H	M

P18PEPD013 POWER QUALITY

P18PEPD013	**POWER QUALITY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- Students will be able to understand the different power quality issues to be addressed.
- Understand the recommended practices by various standard bodies like IEEE, IEC, etc. onvoltage& frequency, harmonics.
- Understanding STATIC VAR Compensators.

SYLLABUS

Module I **5 Hours**

Introduction-power quality-voltage quality-overview of powerQuality phenomena classification of power quality issues.Quality phenomena classification of power quality issues.Power quality measures and standards-THD-TIF-DIN-C-message weights.Flicker factor transient phenomena-occurrence of power quality problemsPower acceptability curves-IEEE guidesStandards and recommended practices.

Module II **8Hours**

Harmonics-individual and total harmonic distortionRMS value of a harmonic waveformTriplex harmonics. Important harmonic introducing devices.SMPSThree phase power converters-arcing devices saturabledevicesHarmonic distortion of fluorescent lamps-effect of power system harmonicson power system equipment and loads.

Module III **6Hour**

Modeling of networks and components under non-sinusoidal conditionsTransmission and distribution systemsShunt capacitors-transformers.Electricmachines.Ground systems loads that cause power quality problems.Ground systems loads that cause power quality problems.Power quality problems created by drives and its impact on drive.

Module IV **6Hours**

Power factor improvement- Passive Compensation.PassiveFiltering.HarmonicResonance.Impedance Scan AnalysisPower Factor Corrected Single Phase Front EndControl Methods for Single Phase APFC.Three Phase APFC and Control TechniquesPFC based on Bilateral Single Phase and Three Phase Converter.

Module V **16Hours**

Hamilton-Jacobi-Bellman equation - model reference adaptivesystemsIntroduction to design method based on the use of Liapunovfunction (MRAS) - Design hypothesis.Design and simulation of variable structure adaptive model followingcontrol.

Text/References:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood,”Power system Harmonic Analysis”, Wiley,

COURSE OUTCOMES (COs)	
CO1	Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads.
CO2	To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components.
CO3	To introduce the student to active power factor correction based on static VAR compensators and its control techniques

CO4	To introduce the student to series and shunt active power filtering techniques for harmonics.
CO5	To Design and simulate various 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		H	M	--
	CO2	H	H	H		L	M	--
	CO3	H	H	H		L	M	--
	CO4	H	M	H	M	H	M	--
	CO5	H	M	H	M	H	M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low					
COURSE	PEO1	PEO2	PEO3	PEO4	PEO5
P18PEPD013 Power Quality	H	L	--	--	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD013 Power Quality**	H	H	L			M	-

P18PEPD014 APPLIED MATHEMATICS

P18PEPD014	**APPLIED MATHEMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To apply all taught techniques to unseen problems, and present basic concepts of matrices and ma algebra, linear transformation, vector spaces, Random variable compute and interpret m correlation/covariance, calculus is major branch of optimization deals with extreme values in function spaces.

Module I Advanced Matrix Theory 9 Hours

Eigen values using QR transformations generalized eigenvectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

Module II Calculus Of Variations 9 Hours

Variation and its properties– Euler's Equation –Functional dependent on first andhigher order derivatives – functional dependent on functions of several independent variables – constraints in the form of a functional isoperimetric problems – Direct method – Ritz and Kantorovich methods – Boundary value problems.

Module III Special Functions 9 Hours

Series solutions – Bessel's equations – Bessel functions – Recurrence relations generating functions and orthogonal of Bessel's functions of the first kind Legendry's equations, Legendary polynomials – Rodriguez's formula applications to boundary value problems

Module IV Probability 9 Hours

Probability concepts – Random variables Discrete and continuous dissimulations – Correlations – Partial, multiple, rank analysis of variance one way, two way process.

Module V Random Process 9 Hours

Poisson process Gaussian process Markov process-Anti Correlations-Cross correlations – Queuing models – quality control – control charts – tolerance limits.

.

Total No. of Periods: 45

Reference:

1. Sankar Rao K: "Introduction to Partial Differential Equations" – Phi Learning Pvt. Ltd-New Delhi, 3rd Edition, 2011.
2. Elsgoth, "Differential Equations and Calculus of Variations" MIR Publishers, Moscow.
3. Grewal B.S. "Higher Engineering Mathematics, Khanna Publications, New Delhi 1989.
4. Androws L.A. "Special Function of Scientist and Engineers"
5. Venkataramn M.K. "higher engineering mathematics, the National Publishing Company, 1990.
6. Narayanan S. Manicasachagam Pillai and Ramaniah G. "Advanced Mathematics for Engineering Students" Vol II and ill, Viswanathan printers Pvt. Ltd., Madras1 1985.
7. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi 1994.

8. Gupta and Kapoor V.K. “Fundamentals of Mathematics Statistics” Sultan Chand & Sons, New Delhi.

COURSE OUTCOMES (COs)	
CO1	Learn to manipulate matrices and to do matrix algebra, determinants, Eigen values Eigen vectors and to solve the system of linear equations
CO2	Learn to analyze Calculus Of Variations
CO3	Learn to understand **Special Functions and equations.**
CO4	Learn to understand the Probability concepts – Random variables Discrete and continuous dissimulations
CO5	Find functional relationship between random inputs and outputs with the use of Random Process 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H		L	H	M
	CO2						H	M
	CO3			H		L	H	M
	CO4						H	M
	CO5					H	H	M
3	Category	Professional Elective Course (PE)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	**PEO1**	**PEO2**	**PEO3**
P18PEPD014 **APPLIED MATHEMATICS**	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1.		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2.	**P18PEPD014** **APPLIED MATHEMATICS**	M		H		M	H	M

PROFESSIONAL ELECTIVE - II

P18PEPD021 STATIC VAR CONTROLLER AND HARMONIC FILTERING

		L	T	P	C
P18PEPD021	**STATIC VAR CONTROLLER AND HARMONIC FILTERING**				
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

Objectives: Students will be able to learn working of Static Reactive Power Compensators & their control and Active &Passive Harmonic Filtering

SYLLABUS

Module I Fundamentals of Load Compensation 7 Hours

Fundamentals of Load Compensation, Steady-State Reactive Power Control in Electric Transmission Systems, Reactive Power Compensation, Dynamic Performance of Transmission Systems.

Module II Power Quality Issues 7 Hours

Power Quality Issues: Sags, Swells, Unbalance, Flicker, Distortion.CurrentHarmonics.Sources of Harmonics in Distribution Systems and Effects.

Module III Static Reactive Power Compensators and their control 8 Hours

Static Reactive Power Compensators and their control. Shunt Compensators, SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control, Series Compensators of thyristors Switched and Controlled Type and their Control, SSSC and its Control, Sub-Synchronous Resonance and damping, Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power System.

Module IV Converters for Static Compensation 8 Hours

Converters for Static Compensation, Single Phase and Three Phase Converters and Standard Modulation, GTO Inverters. Multi-Pulse Converters and Interface Magnetics, Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM), Multi-level inverters of Cascade Type and their modulation. CurrentControl of Inverters.

Module V Passive Harmonic Filtering 8 Hours

Passive Harmonic Filtering, Single Phase Shunt Current Injection Type Filter and its Control, Three Phase Three-wire Shunt Active Filtering and their control using p-qtheory and d-q modeling, Three phase four wire shunt active filters, Hybrid Filtering using Shunt Active Filters, Dynamic Voltage Restorer and its control, Power Quality Conditioner

Module VI Active Harmonic Filtering 7 Hours

Series Active Filtering in Harmonic Cancellation Mode, Series Active Filtering in Harmonic Isolation Mode.

Text/References:

1. Ned Mohan et.al, "Power Electronics", John Wiley and Sons, 2006.
2. G. Massobrio, P. Antognet," Semiconductor Device Modeling with Spice", McGraw-Hill, Inc., 1988.
3. B. J. Baliga," Power Semiconductor Devices", Thomson, 2004
4. V. Benda, J. Gowar, D. A. Grant," Power Semiconductor Devices. Theory and Applications",JohnWiley& Sons1994.

.COURSE OUTCOMES (COs)	
CO1	To Understand the concept of Reactive Power Compensation
CO2	To Understand and gain knowledge Power Quality Issues: Sags, Swells, Unbalance, Flicker, and Distortion.
CO3	To Understand about STATCOMs and their control.
CO4	To Understand about the Converters for Static Compensation, Single Phase and Three Phase Converters.
CO5	To Understand about Passive Harmonic Filtering
CO6	To know more about Active Harmonic Filtering

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	PSO1	PSO2
2	CO1	M	H	M	L	L	M	L
	CO2	M	M	H	L	L	L	M
	CO3	M	M	M	L	M	L	L
	CO4	M	M	L				M
	CO5	M	M	M	L	M	L	M
	CO6		H	M		L	-	H
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

COURSE	PEO1	PEO2	PEO3
P18PEPD021 STATIC VAR CONTROLLER AND HARMONIC FILTERING	H	M	-

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD021 STATIC VAR CONTROLLER AND HARMONIC FILTERING**	M	H	M	M	H	M	L

P18PEPD022 PULSE WIDTH MODULATION FOR PE CONVERTERS

P18PEPD022	**PULSE WIDTH MODULATION FOR PE CONVERTERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 44	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

1. To understand Necessity and Importance of PWM techniques and Implementation of PWM controllers for Power Electronics.

SYLLABUS

Module I Introduction **8 hours**

Introduction to PE converters, Modulation of one inverter phase leg, Modulation of single phase, VSI and 3 phase VSI

Module II Modulation Strategies **8 hours**

Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI.

Module III Converters **8 hours**

Over modulation of converters, programmer modulation strategies.

Module IV Multilevel Inverter **8 hours**

Pulse width modulation for multilevel inverters, Implementation of modulation controller.

Module V Pulse width modulation Techniques **12 hours**

Continuing developments in modulation as random PWM, PWM for voltage unbalance, Effect of minimum pulse width and dead time

Text / References:

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice", John Wiley & Sons, 03-Oct-2003
2. Bin Vew, "High Power Converter", Wiley Publication
3. Marian K. Kazimicrczuk, "Pulse width modulated dc-dc power converter", Wiley Publication

COURSE OUTCOMES (COs)	
CO1	To understand the concept of Voltage Source Inverter
CO2	To understand the concept of Current Source Inverter.
CO3	To gain the knowledge of over modulation of converters, programmer modulation strategies.
CO4	To learn more about Pulse Width Modulation for multilevel inverters
CO5	Compare performance of converter for different PWM techniques

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

1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M	H	H		M	H	
	CO2	M	H	H		M	H	
	CO3	M	H	H		M	H	
	CO4	M	H	H		M	H	
	CO5	M	H	H		M	H	
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PEPD022 PULSE WIDTH MODULATION FOR PE CONVERTERS	H	M	H

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD022** **PULSE WIDTH MODULATION FOR PE CONVERTERS**	M	H	H		M		

P18PEPD023POWER SEMICONDUCTOR DEVICES AND MODELING

P18PEPD023	**POWER SEMICONDUCTOR DEVICES AND MODELING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: Students will be able to learn the ability to understand power semiconductor devices and modeling.

SYLLABUS

Module I Introduction of BJT 9 hours

Basic structure of Diodes and V-I characteristics,Schottky diodes, snubber requirements for diodes, diode snubber, modelling and simulation of Power diodes, Basic structure of BJT's and V-I characteristics, Device protection- snubber requirements for BJT'S and snubber design switching aids, modeling and simulation of power BJT'S.

Module II Design and Modelling of Thyristor 9 hours

Basic structure of Thyristors - V-I characteristics, turn-on process, on-state operation, turn - off process, switching characteristics, turn-on transient and di/dt limitations, turn-off transient, turnoff time and reapplied dv/dtlimitations,gate drive requirements, ratings of thyristors, snubber requirements and snubber design, modelling and simulation of Thyristor.

Module III Analysis of MOSFET 9 hours

Power MOSFET'S - Basic structure, V-I characteristics, turn-on process, on state operation, turnoff process, switching characteristics, resistive switching specifications, clamped inductive switching specifications - turn-on transient and di/dt limitations, turn-off transient, turn off time, switching losses, effect of reverse recovery transients on switching stresses and losses - dv/dt limitations, gating requirements, gate charge - ratings of MOSFET'S, FBSOA and RBSOA curves, device protection -snubber requirements, modeling and simulation of Power MOSFET'S

Module I Gate Bipolar Transistors (IGBT'S) 9 hours

Gate Bipolar Transistors (IGBT'S): Basic structure and operation, latch up IGBT, switching characteristics, resistive switching specifications, clamped inductive switching specification – IGBT turn-on transient, IGBT turn off transient- current tailing - gating requirements ,ratings of IGBT'S, FBSOA and RBSOA curves, switching losses – minimum on and off state times, switching frequency capability – overcurrent protection of IGBT'S, short circuit protection, snubber requirements and snubber design.

Module V Power Semiconductor Devices 9 hours

New Power Semiconductor Devices : MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, base resistance controlled thyristors, emitter switched thyristors, thermal design of power electronic equipment, modelling and simulation, heat transfer by conduction, transient thermal impedance, heat sinks, heat transfer by radiation and convection - heat

sinkselection for power semiconductor devices.

Suggested reading

1. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics Converters, Applications, and Design”, 3rd Edition. Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, “Semiconductor Device Modeling with Spice”, McGrawHill, 2nd Edition, 2010.
3. B. JayantBaliga, “Power Semiconductor Devices”, 1st Edition, International Thompson Computer Press, 1995.
4. V. Benda, J. Gowar, and D. A. Grant, “Discrete and Integrated Power Semiconductor Devices: Theory and Applications”, John Wiley & Sons, 1999.

COURSE OUTCOMES (COs)	
CO1	To understand the Basic structure , modeling and simulation of power BJT’S.
CO2	To understand Basic structure of Thyristors - V-I characteristics and modeling of Thyristors.
CO3	To gain knowledge in modeling of Power MOSFET’S.
CO4	To gain fair knowledge in modeling of Gate Bipolar Transistors (IGBT’S)
CO5	To learn more about new Power Semiconductor 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1		H	H	M	M	H	H
	CO2	M	H	H	M	M	H	H
	CO3	M	H	H	M	M	H	H
	CO4	M	H	H	M	M	H	H
	CO5		H	H	M	M	H	H
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD023 **POWER SEMICONDUCTOR DEVICES AND MODELING**	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD023** **POWER SEMICONDUCTOR DEV AND MODELING**	M	H	H	M	M	H	H

P18PEPD024SPECIAL ELECTRICAL MACHINES AND CONTROLLERS

P18PEPD024	**SPECIAL ELECTRICAL MACHINES AND CONTROLLERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: Students will be able to learn the ability to understand control of electrical machines.

SYLLABUS

ModuleI Stepper Motor 9 Hours

Operation, Types of stepper motors - Torque production, modes of excitation, Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor

ModuleII Switched Reluctance Motors 9 Hours

Operation, Torque equation, Power controllers, speed torque characteristics - Switched Reluctance Motors

ModuleIII Permanent Magnet Brush less DC Motors 9 Hours

Difference between mechanical and electronic Commutators, Hall sensors, Optical sensors, Square - Wave permanent magnet brushless motor drives, torque and EMF equation, torque - speed characteristics of Permanent Magnet Brush less DC Motors - controllers PM DC Motor

ModuleIV Control of Permanent Magnet Synchronous Motors 9 Hours

Principle of operation, EMF, power input and torque expressions, phasor diagram, power converters, Torque - Speed characteristics, self-control, controllers for Permanent Magnet Synchronous Motors

Module V Linear SynchronousMotors 9Hours

Construction and principle of operation of Linear Induction Motor - Universal Motor - Linear Synchronous motor - Applications.

REFERENCES:

1. Brush Permanent Magnet and Reluctance Motor Drives – Miller T.J.E. Clarendon Press, Oxford, 1989.
2. Permanent magnet and Brushless DC motors, kenjo T. and Naganori S. Clarendon Press, Oxford, 1989.
3. Stepping Motors and their Microprocessor Control – Kenjo T. Clarendon Press, Oxford, 1989.

COURSE OUTCOMES (COs)	
CO1	To learn about the construction and working principle of Stepper Motor and control concepts.
CO2	To learn about the construction and working principle Of Switched Reluctance Motor
CO3	To learn about the construction and working principle of Permanent Magnet Brushless Dc Motors
CO4	To learn about the construction and working principle of Permanent Magnet Synchronous Motors
CO5	To learn about Construction and principle of operation of Linear Induction Motor 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		M		H	H	L
	CO2		L				H	L
	CO3					H	H	L
	CO4	H		M			H	L
	CO5			L	H		H	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD024 **SPECIAL ELECTRICAL MACHINES AND CONTROLLERS**	H	L	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD024** **SPECIAL ELECTRICAL MACHINES CONTROLLERS**	H	L	M	H	H	H	L

PROFESSIONAL ELECTIVE – III

P18PEPD031SWITCHED MODE AND RESONANT CONVERTERS

P18PEPD031	**SWITCHED MODE AND RESONANT CONVERTERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Analysis of Power Converters				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: Acquire knowledge about the principles of operation of non-isolated and isolatedhard-switched DC-DC converters.

SYLLABUS

Module I Basics of Converters 6 Hours

Buck, Boost, Buck-Boost SMPS Topologies, Basic Operation-Waveforms - modes of operation -switching stresses, Switching and conduction losses. Optimum switching frequency, Practical voltage, current and power limits - design relations, Voltage mode control principles, Push-Pull and Forward Converter Topologies - Basic Operation, Waveforms, Flux Imbalance Problem and Solutions.

Module II Filters 8 Hours

Transformer Design. Output Filter Design. Switching Stresses and Losses, Forward Converter Magnetics, Voltage Mode Control, Half and Full Bridge Converters, Basic Operation and Waveforms, Magnetics, Output Filter, Flux Imbalance, Switching Stresses and Losses, Power Limits, Voltage Mode Control.

Module III Resonant Converters 7 Hours

Classification of Resonant Converters. Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero, Voltage Switching Clamped Voltage Topologies, Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter, Fly back Converter- discontinuous mode operation, waveforms, control,Magnetics- Switching Stresses and Losses, Disadvantages – Continuous Mode Operation, waveforms, control, design relations.

Module IV SMPS 8 Hours

Voltage Mode Control of SMPS- Loop Gain and Stability Considerations, Error Amp– frequency Response and Transfer Function, Trans-conductance Current Mode Control of SMPS, Current Mode Control Advantages, Current Mode Vs Voltage Mode.

Module V IC in SMPS 8 Hours

Current Mode Deficiencies, Slope Compensation, Study of a typical Current Mode PWM Control IC UC3842. Modeling of SMPS, Small Signal Approximation- General Second Order Linear Equivalent Circuits, Study of popular PWM Control ICs (SG 3525, TL 494, MC34060 etc.

Module VI Filters on SMPS 8 Hours

DC Transformer, Voltage Mode SMPS Transfer Function, General Control Law Consideration, EMI Generation and Filtering in SMPS - Conducted and Radiated Emission Mechanisms in SMPS, Techniques to reduce Emissions, Control of Switching Loci, Shielding and Grounding, Power Circuit Layout for minimum EMI, EMI Filtering at Input and Output, Effect of EMI Filter on SMPS Control Dynamics. Introduction to Resonant Converters.

TEXT BOOK AND REFERENCE

1. Abraham I Pressman, “Switching Power Supply Design,” McGraw Hill Publishing Company, 2001.
2. Daniel M Mitchell, “DC-DC Switching Regulator Analysis,” McGraw Hill Publishing Company-1988.
3. Ned Mohan et.al, “Power Electronics,” John Wiley and Sons 2006.

COURSE OUTCOMES (COs)	
CO1	Students will be able to understand different types of converters
CO2	Students will be able to understand the basics of filters
CO3	Students will be able to understand different resonant converter topologies
CO4	Students will be able to understand different switch mode topologies & control methods
CO5	To understand concept of ICs in PWM
CO6	To understand concept of DC transformer & EMI filter and Effect of EMI Filter on SMPS Control Dynamics.

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	PSO1	PSO2
2	CO1		L			H	M	L
	CO2	L					M	M
	CO3						H	H
	CO4	M	M				H	H
	CO5					H		H
	CO6	M	L					H

3	Category	Professional Elective Course (PEC)
4	Approval	47thMeeting of Academic Council

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD031 SWITCHED MODE AND RESONANT CONVERTERS	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD031 SWITCHED MODE A RESONANT CONVERTERS**	H	H	L			H	M

P18PEPD032 INDUSTRIAL LOAD MODELING AND CONTROL

P18PEPD032	**Industrial Load Modeling and Control**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Digital Control of Power Electronic and Drive Systems				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To gain fundamental knowledge of Industrial Load Modeling and Control..

SYLLABUS

Module I Introduction to industrial load 9 hours

Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of IndustrialLoads, Continuous and Batch processes -Load Modeling.

Module II Optimization and control 8 hours

Electricity pricing – Dynamic and spot pricing –Models, Direct load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load Models, Optimization and control algorithms - Case studies.

Module III Power Management 8 hours

Reactive power management in industries controls-power quality impacts application of filters Energy saving in industries.

Module IV Modeling of loads 8 hours

Cooling and heating loads, loadprofilingModeling- Cool storageTypes-Control strategiesoptimal operation, Problem formulation- Case studies.

Module V Energy banking system 6 hours

Captive power units-operating and control strategies Power Pooling- Operation models-Energy banking Industrial Cogeneration. Captive power units-operating and control

Module VI Selection of Schemes 6 hours

Selection of Schemes .Optimal Operating Strategies, Peak load saving Constraints, Problem formulation- Case study, Integrated Load management for Industries.

Text Books

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989

2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28

Reference Books:

1.Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981

2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.

3.I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995

4.IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

COURSE OUTCOMES (COs)	
CO1	To understand the Electric Energy Scenario-Demand Side Management-Industrial Load Management
CO2	To understand the formulation of load Models, Optimization and control algorithms - Case studies.
CO3	To Understand Analyze systems in complex frequency domain and Study Reactive power management in Industries
CO4	To understand the Knowledge about load control techniques in industries and its Modeling.
CO5	To Learn different types Captive power units-operating and control
CO6	To gain knowledge of Selection of Schemes ,Optimal Operating Strategies, Peak load saving Constraints and Problem formulation.

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	PSO1	PSO2
2	CO1	H	H	H	L		H	L
	CO2	H	M		M		H	L
	CO3	H	H	H	L		H	L
	CO4	M	M		M		H	L
	CO5	H	M		M		H	L
	CO6	H	H	H	L		H	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD032 Industrial Load Modeling and Control	H	M	L

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD032Industrial Load Modeling and Control**	H	H	H	L		H	L

P18PEPD033 ADVANCED DIGITAL SIGNAL PROCESSING

P18PEPD033	**Advanced Digital Signal Processing**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Students will be able to understand advanced DSP and Linear Signal Models and Estimation of Power Spectrum

SYLLABUS

Module I Introduction to Signals and Systems, Fourier Transform and z- Transforms 9 hours

Discrete time signals, Linear shift invariant systems,Stability and causality, Sampling of continuous time signals, discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms.

Module II IIR Filters 8 hours

Linear convolution using DFT, Computation of DFT,and Design of IIR digital filters from analog filters, Impulse invariance method, bilinear transformation method.

Module III FIR Filters 8 hours

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations, Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

Module IV Finite Word Length Effects 8 hours

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zeroInput limit cycles in IIR filters, Linear Signal Models, All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

Module V Linear Signal Models and Estimation of Power Spectrum 12hours

Optimum linear filters Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Suggested reading

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", TataMc Grow-Hill Edition 1998

2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal processing", Mc Grow Hill international editions.-2000

COURSE OUTCOMES (COs)	
CO1	Knowledge about the concept of Introduction to Signals and Systems, Fourier Transform and z- Transforms.
CO2	Study the design techniques for IIR filters and their realization structures.
CO3	Study the design techniques for FIR filters and their realization structures.
CO4	Acquire knowledge about the finite word length effects in implementation of digital filters.
CO5	Knowledge about the various linear signal models and estimation of power spectrum of stationary random.

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	PSO1	PSO2
2	CO1	H		M	M	H	H	M
	CO2		H			M	H	H
	CO3	H	H	M			H	H
	CO4						M	M
	CO5	H			M		H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD033 ADVANCED DIGITAL SIGNAL PROCESSING	M	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD033 ADVANCED DIGITAL SIGNAL PROCESSING**	H	H	H	H	H	M	M

P18PEPD034 SOLID STATE AC DRIVES

P18PEPD034	**SOLID STATE AC DRIVES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Analysis of Power Inverter				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

- Learn characteristics and control of solid state AC motors drives.
- Learn digital control AC drive**s**

SYLLABUS

Module I Stator Voltage Control of Induction Motor 9 Hours

Torque, slip characteristics, operation with different types of loads, performance comparison of different AC power controllers speed reversal, closed loop control

Module II Stator Frequency Control 9 Hours

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.

ModuleIII Rotor Resistance Control 9 Hours

Torque, slip characteristics, types of rotor choppers, torque equation, constant torque operation, TRC strategy, combined stator voltage control and rotor resistance control

Module IV Slip Power Recovery Scheme 9 Hours

Torque equation, torque – slip characteristics-power factor consideration, Sub-Synchronous operation closed loop control.

Module V Synchronous Motor Drives 9Hours

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

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

COURSE OUTCOMES (COs)	
CO1	Ability to understand the concept of Stator Closed Loop Voltage controller
CO2	To understand the concept of variable speed induction motor
CO3	To gain the knowledge of a resistance control, closed loop control schemes for slip power recovery
CO4	To gain knowledge in field oriented control of Induction machine
CO5	To understand performance of speed control synchronous motor drives

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	PSO1	PSO2
2	CO1	H	L		H	H	H	L
	CO2			H	H		H	L
	CO3						H	L
	CO4		L	M			H	L
	CO5	H	L				H	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD034 **SOLID STATE AC DRIVES**	H	L	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD034** **SOLID STATE AC DRIVES**	H	L	M	H	H	H	L

PROFESSIONAL ELECTIVE – IV

P18PEPD041 ADVANCED MICRO-CONTROLLER BASED POWER ELECTRONIC SYSTEMS

P18PEPD041	**ADVANCED MICRO-CONTROLLER BASED POWER ELECTRONIC SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To understand the architecture of advance microcontrollers and applications of micro controllers in ac, dc drives& renewable Energy sources.

SYLLABUS

Module I 8051 Micro Controller 9 Hours

Micro-Controllers-Intel 8051, Intel 8056-Registers, Memories I/O Ports, Serial Communication Timers, Interrupts,– Assembly language programming Addressing-Operations Stack Subroutines Interrupts-DMA

Module II PIC 16F877 Controller 9 Hours

PIC 16F877- Architecture- operation -Programming Interfacing Memory/ I/O Devices Serial I/O and data communication.

Module III Microcontroller Based Firing Scheme for Converters

Firing schemes for single phase and three phase rectifiers-3 phase AC choppers, firing at variable frequency environment, firing scheme for DC Choppers, voltage and current communication inverters, types of pulse with modulation techniques, their implementation, using Microcontroller

Module IV **Microcontroller Application for Electrical Drives** **9 Hours**

Speed control of D C Motor-Induction Motor-Synchronous Generator-Stepper Motor-BLDC and PMDC motor

Module V **Microcontroller Application to Renewable Energy Sources** **9 Hours**

Concept of control system of Solar and Wind Turbine -Converter Control for Wind Turbine-Control of single phase Solar Inverter- Case studies of Wind-Solar integration -Microcontroller-Based Solar Tracking System

Text Books

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
3. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005

Reference Books

1. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005

Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18FSeries", Elsevier, 2008Microchip datasheets for PIC16F877**:**

3.John B. Peatman-"Design with microcontrollers"- McGraw Hill international Singapore 1989

http://www.da-engineering.com/wp-content/uploads/2014/11/Power-converters-and-control-of-renewable-energy-systems_DA.pdf

2. COURSE OUTCOMES (COs)	
CO1	To gain knowledge of 8051 Micro Controller and its architecture
CO2	To gain knowledge of PIC 16F877- Architecture- operation
CO3	Learn to understand the Microcontroller Based Firing Scheme for Converters
CO4	To understand Application of Microcontroller for Electrical Drives
CO5	To know the Application of Microcontroller to Renewable Energy Sources

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	PSO1	PSO2
2	CO1	H		H		L	H	M
	CO2						H	M
	CO3			H		L	H	M

	CO4						H	M
	CO5					H	H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	Meeting of Academic Council, 2018						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	**PEO1**	**PEO2**	**PEO3**
P18PEPD014 ADVANCED MICRO-CONTROLLER BASED POWER ELECTRONIC SYSTEMS	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1.		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2.	**P18PEPD014 ADVANCED MICRO-CONTROLLER BASED POWER ELECTRONIC SYSTEMS**	M		H		M	H	M

P18PEPD042DISTRIBUTED GENERATION AND MICROGRID

	DISTRIBUTED GENERATION AND MICROGRID	**L**	**T**	**P**	**C**
P18PEPD042	Total Contact Hours – 45	3	0	0	3
	Prerequisite – nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES Students will be able to

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Micro grid and its configuration

SYLLABUS

Module I Introduction 9Hours

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.

Module II Distributed Generations (DG) 9Hours

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

Module III Impact of Grid Integration 9Hours

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.

Module IV Basics of a Micro grid 9Hours

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,

Module V Control and Operation of Micro grid 9Hours

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 smart micro grids

Reference Books:

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.
3Chetan 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, "Biomass Re-generable Energy", John Wiley, New York, 1987.
John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2006

COURSE OUTCOMES (COs)	
CO1	Review the conventional power generation& Analyze the concept of distributed generation and installation
CO2	To analyse the Distributed Generation and its Topology
CO3	Design the grid integration system with conventional and non-conventional energy sources
CO4	Design the dc and ac micro grid
CO5	Analyze power quality issues and control operation of micro grid

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

1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H		L	H	M
	CO2	H		H		L	H	M
	CO3	H		H		L	H	M
	CO4	H		H		L	H	M
	CO5	H		H		L	H	M
	CO6	H		H		L	H	M
3	Category	Program Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD042 DISTRIBUTED GENERATION AND MICROGRID	M	H	L

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD042DISTRIBUTED GENERATION AND MICROGRID**	H		H		L	H	M

P18PEPD043 SMART GRIDS

	SMART GRIDS	**L**	**T**	**P**	**C**
P18PEPD043	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES Students will be able to:

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its Solution through smart grid.

SYLLABUS

Module I Introduction to Smart Grid 6 hours

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid.

Module II Smart meters and Advanced Metering Infrastructure 8 hours

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR),Outage Management System (OMS),Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home& Building Automation, Smart Substations, Substation Automation, Feeder Automation

Module III Smart Grid Technologies 7 hours

Geographic Information System (GIS),Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit(PMU).

Module IV Protection and Control of Micro Grid 8 hours

Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection& control of micro-grid, Plastic& Organic solar cells, thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

Module V Power QualityManagement in Smart Grid 8 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.

Module VI High Performance Computing for Smart Grid Applications 8 hours

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, WI-Max based communication, Wireless Mesh Network. Basics of CLOUD Computing &Cyber Security for Smart Grid, Broadband over Power line (BPL). IP based protocols.

Text / References:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC

Press, 2009.

3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications",

Wiley 2012.

4. Stuart Borlas'e, "Smart Grid:Infrastructure, Technology and solutions "CRC Press.
5. A.G.Phadke , "Synchronized Phasor Measurement and their Applications", Springer.

COURSE OUTCOMES (COs)	
CO1	To know the concept of Smart Grid, Evolution of Electric Grid, Concept of Smart Grid,
CO2	To gain knowledge about Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading
CO3	To understand the Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage like Batter, Wide Area Measurement System (WAMS), Phase Measurement etc
CO4	To understand the Protection& control of micro-grid and control
CO5	To understand the Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.
CO6	To understand the communication, Wireless Mesh Network, Basics of CLOUD Computing &Cyber Security for Smart Grid.

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

1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H		L	H	M
	CO2	H		H		L	H	M
	CO3	H		H		L	H	M
	CO4	H		H		L	H	M
	CO5	H		H		L	H	M
	CO6	H		H		L	H	M
3	Category	Program Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD042 SMART GRIDS	M	H	L

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD042 SMART GRIDS**	H		H		L	H	M

P18PEPD044SOLID STATE DC DRIVES

P18PEPD044	**SOLID STATE DC DRIVES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

- Learn characteristics and control of solid state DC motors drives.
- Learn digital control DC drive**s**

SYLLABUS

Module I Review Of Conventional Dc Drives 9 Hours

Different technique of speed control and method of braking of series and separately excited motor, ward-Leonard speed control, models and transfer function of series and separately excited dc motor.

Module II Converter Control of Dc Motor 9Hours

Analysis of series and separately excited DC motor with three phase and single phase converter operating in different modes and configurations. Problems on converter fed dc machine. CLC and TRC strategies.

Module III Chopper Control of Dc Motors 9 Hours

Analysis of series and separately excited de motor fed from different choppers, effect of saturation in series motor, CLC and TRC strategies, Microprocessor based firing circuit.

Module IV Design of Converter Fed Dc Drives 9 Hours

Speed loop, current loop, armature current reversal, digital controller and microprocessor based firing circuits, simulation.

Module V Intelligent Controller for Drives 9 Hours

Microcomputer implementation of control function fuzzy, neuro, fuzzy-neuro controllers.

TEXT BOOKS:

1. Dubey, G.K. ''Power Semiconductor controlled drives'', Prentice Hall international, New Jersey,1989
2. SEN. P. C. ''Thyristor DC Drives'', John Wiley Sons, Newyork, 1981.

REFERENCES:

1. SUBHRAMANYYAM. V. ''Electric Drives – Concepts and Applications'', Tata-McGraw Hill, Publishing Co., Ltd. New Delhi, 1994.
2. B. K. Bose. ''Expert System, Fuzzy logic and Neural Network application in power Electronics and Motion Control'', Proceeding of the IEEE Special issue on power electronics and motion control, August- 1994, PP-1303.

COURSE OUTCOMES (COs)	
CO1	Ability to understand the concept of Conventional DC Drives
CO2	To get knowledge to analyze **Converter Control of Dc Motor**
CO3	To analyze chopper circuit system for DC motor
CO4	To gain knowledge on different controls on converter fed DC drives
CO5	To design and implement intelligent control system for DC drives

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	PSO1	PSO 2
2	CO1	H	L	M	H	H	H	L
	CO2	H	L	L	H	H	H	L
	CO3	H	L	M	H	H	H	L
	CO4	H	L	M	H	H	H	L
	CO5	H	L	L	H	H	H	L
3	Category	Professional elective course(PE)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PEPD044 SOLID STATEDC DRIVES	H	L	M

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD044SOLID STATE DC DRIVES**	H	L	M	H	H	H	L

PROFESSIONAL ELECTIVE –V

P18PEPD051 SCADA SYSTEM AND APPLICATIONS

P18PEPD051	**SCADA SYSTEM AND APPLICATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital Control of Power Electronic and Drive Systems				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To understand the operation, communication, functions and applications of SCADA.

SYLLABUS

Module I Introduction to SCADA **7 Hours**
Introduction to SCADA-Data acquisition systems-Evolution of SCADA-Communication technologies.

Module II Monitoring of SCADA **7 Hours**
Monitoring and supervisory functions-SCADA applications in Utility Automation-Industries SCADA.

Module III SCADA System Components **7Hours**
Industries SCADA System Compone **Chopper Control of Dc Motors** nts-Schemes- Remote Terminal Unit (RTU)-Intelligent Electronic
Devices (IED)-Programmable Logic Controller (PLC)-Communication Network, SCADA Server,
SCADA/HMI Systems

Module IV SCADA Architecture **8 Hours**
SCADA Architecture-Various SCADA architectures, advantages and disadvantages of each system-
Single unified standard architecture -IEC 61850.]

Module V SCADA Communication **8 Hours**
SCADA Communication- various industrial communication technologies-wired and wireless methods and fiber optics-Open standard communication protocols.

Module VI SCADA Application **8 Hours**
SCADA Applications: Utility applications-Transmission and Distribution sector operations, monitoring, analysis and Improvement- Industries-Oil, gas and Water.

.Text/Reference Books

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981
2. Penram International Publishing (India), 1994
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005

6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18FSeries", Elsevier, 2008Microchip datasheets for PIC16F877

CO1	To Understand the basics of SCADA
CO2	To study the Industrial Applications Of SCADA
CO3	To study about the components of SCADA and HMI system
CO4	To Understand the architecture of SCADA and IEC 61850
CO5	To Understand the Communication Technologies in SCADA
CO6	To Study the applications of SCADA.

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	PSO1	PSO2
2	CO1	H				H	H	M
	CO2		M		H		H	M
	CO3	H	M		H		H	M
	CO4						H	M
	CO5			M			H	M
	CO6	H			H	H	H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PEPD051SCADA SYSTEM AND APPLICATIONS	M	H	H

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

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	P18PEPD051SCADA SYSTEM AND APPLICATIONS	H			H	H	H	M

P18PEPD052 FACTS AND CUSTOM POWER DEVICES

	FACTS AND CUSTOM POWER DEVICES	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3

P18PEPD052	Prerequisite – Digital Control of Power Electronic and Drive Systems
	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES

- Students will be able to learn the active and reactive power flow control in power system
- To understand the need for static compensators.
- To develop the different control strategies used for compensation.

SYLLABUS

ModuleI Introduction of FACTS 9Hours

Reactive power flow control in Power Systems- Control of dynamic power unbalances in Power System - Power flowcontrol- Constraints of maximum transmission line loading- Benefits of FACTS Transmission line compensation- Uncompensated line -Shunt compensation, Series compensation Phaseangle control- Reactive power compensation Shunt and Series compensationPrinciples- Reactive compensation at transmission and distribution level.

Module II STATCOM Operation and control 9 Hour

Static versus passive VAR compensator- Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM –Compensator control- Comparison between SVC and STATCOM

Module III Static series compensation 9 Hours

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulator- TCVR and TCPAR Operation and Control Applications, Static series compensation- GCSC, TSSC, TCSC and Static synchronous series compensators andtheir Control

Module IV UPFC Controller 9 Hours

SSR and its damping Unified Power Flow Controller Circuit Arrangement, Operation and control of UPFC- Basic Principle of P and Q control- Independent real and reactivepower flow control- Applications

Module V FACTS Controller 9 Hours

Introduction to interline power flow controller.Modeling and analysis of FACTS Controllers-Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, loads that create harmonics- modeling, harmonic propagation, series and parallel resonancesmitigation of harmonics- passive filters, active filtering – shunt , series and hybrid and theircontrol.Voltageswells, sags, flicker, unbalance and mitigation of theseproblems by power line conditioners IEEE standards on power quality.

Text/References:

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New AgeInternationalPublishers, 2007.
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling AndControl”,SpringerVerlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible ACTransmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar, S.Ashok , “FACTS Controllers & Applications”, E-book edition, NalandaDigital Library, NIT Calicut, 2003.

5. G. T.Heydt, “Power Quality”, McGraw-Hill Professional, 2007.
6. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

COURSE OUTCOMES (COs)	
CO1	Acquire knowledge about the fundamental principles of FACTS and Reactive power flow control in Power Systems
CO2	Learn about STATCOM Operation and control
CO3	To learn about Static series compensation .
CO4	To learn about unified power flow controllers and their applications
CO5	To introduce the students to Facts 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H			M	--
	CO2	H				M	M	--
	CO3		M				M	--
	CO4			H		H	M	--
	CO5				H		M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD052FACTS AND CUSTOM POWER DEVICES	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD052FACTS AND CUSTOM POWER DEVICES**	H	H	L			M	-

P18PEPD053HVDC

	HVDC	**L**	**T**	**P**	**C**
	Total Contact Hours –45	3	0	0	3

P18PEPD053	Prerequisite – Nil
	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES

Students will be able to:

1. Understand state of the art HVDC technology and Methods to carry out modeling and analysis of HVDC system.

SYLLABUS

Module I Introduction 7Hours

Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

Module II Converter and HVDC System 7 Hours

Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

Module III Control Techniques 8 Hours

Individual phase control, Equidistant firing controls, higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection

Module IV Multi-Terminal HVDC Systems 8 Hours

Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems.

Module V Modelling of HVDC Systems 7 Hours

Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

Module VI Standards of HVDC System 8Hours

Introduction to relevant national and international standards, safe clearances for HV, Study regulations for HV tests, Digital techniques in HV measurements.

Text / References:

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.
3. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
4. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

COURSE OUTCOMES (COs)	
CO1	To expose the students to the state of the art HVDC technology.
CO2	To gain the knowledge of Rectifiers, Inverters & control of HVDC converters
CO3	To analyze the various control characteristics of converters
CO4	To learn about the Multi-Terminal HVDC Systems
CO5	Knowledge of modeling and analysis of HVDC system .
CO6	To learn about standards, study regulation of HV tests & Digital techniques of HV measurements

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1		M	M		M	H	M
	CO2	M	H				H	M
	CO3	M		H		M	H	M
	CO4						H	M
	CO5	M	H	H			H	M
	CO6			H			H	M
3	Category	Program Elective Course(PE)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD053HVDC	H		H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD053HVDC**	M	H	H		M	H	M

P18PEPD054DESIGN OF INTELLIGENT CONTROLLERS

P18PEPD054	**DESIGN OF INTELLIGENT CONTROLLERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Digital Control of Power Electronic and Drive Systems				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To understand the Design of Intelligent Controllers using Fuzzy and Neural techniques and their applications.

SYLLABUS

Module I Introduction 9 Hours

Model based controllers – adaptive controllers – model reference adaptive control –model identification adaptive controllers – optimal control – predictive control

Module II Artificial Intelligent Based Controllers 9 Hours

Natural language system – perception system for vision speech and touch – export or

knowledge- representation – inference strategy – expert controller.

Module III Fuzzy Logic System 9 Hours

Introduction – fuzzy controller - fuzzier – knowledge base-defuzzyfier-fuzzy logic tools – fuzzy logic controller.

Module IV Artificial Neural Network 9 Hours

Introduction – Artificial Network –Classification Based on Topology and Learning Method – Learning Rules Perception – Multi I/P and multi O/P perception -multi layer artificial neural network – error propagation learning algorithm – neural controllers.

Module V Application of FLCAnd Neural Networks 9 Hours

Non – Linear fuzzy control – PID – with FLC – sliding mode FLC – adaptive – fuzzy control application – Case studies.

References:

1. Hetz, John Krogh, Andrsand Palmer, Richard, G. "Introduction to theory of neural computation," Addison – Wesley New York 1991.
2. King. P.J. and Momdoni E.H "The Applications of fuzzy control systems to industrial processes' 6th IFAC congress on control technology in the service of man, 1975.
3. Nelson, Morgan, " Artifical Neural Networks: Electronic implementation " IEEE Computer Society Press, USA1990.

COURSE OUTCOMES (COs)	
CO1	To understand model based Conventional controllers
CO2	To understand the knowledge of different artificial intelligent controllers
CO3	To acquire knowledge of Fuzzy logic system
CO4	To acquire knowledge of Neural system
CO5	To design PID based neuro Fuzzy system for power electronic system

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M			H	H	H	M
	CO2		L		H		H	M
	CO3	H			H	H	H	M
	CO4	H			H		H	M
	CO5		L		H		H	M
3	Category	Program Elective Course(PE)						
4	Approval	47thMeeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPD054: DESIGN OF INTELLIGENT			

CONTROLLERS	M	M	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPD054: DESIGN OF INTELLIGENT CONTROLLERS**	H	L		H	H	H	H

OPEN ELECTIVE

P18OEBA001 BUSINESS ANALYTICS

		L	**T**	**P**	**C**
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Business Administration Course approved in 47th Meeting of Academic Council				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9

Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in 4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual
4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002 OPERATIONS RESEARCH

P18OEMA002	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering Course approved in 47th Meeting of Academic Council				

OBJECTIVES

- To apply the dynamic programming to solve problems of discreet and continuous variables.
- To apply the concept of non-linear programming.

- An ability to carry out the sensitivity analysis.
- An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques 9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method 9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM 9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming 9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical AnalysisandSimulation of Game Theory 9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEME003 INDUSTRIAL SAFETY

P18OEME003	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering Course approved in 47th Meeting of Academic Council				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.

5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

Total No. of Periods: 45

References Books:

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.

P18OEBA004 COST MANAGEMENT OF ENGINEERING PROJECTS

P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering Course approved in 47th Meeting of Academic Council				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management 10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005 COMPOSITE MATERIALS

P18OEME005	COMPOSITE MATERIALS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering Course approved in 47th Meeting of Academic Council				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006 WASTE TO ENERGY

P18OEEE006	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering Course approved in 47th Meeting of Academic Council				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit I& Audit II

P18ACEN001AUDIT: ENGLISH FOR RESEARCH PAPER WRITING

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS

Module I **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

Module III **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, theFinal Check.

Module IV **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

Module V **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Module VI **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg
London, 2011

P18ACCE002AUDIT: DISASTER MANAGEMENT

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

Module I Introduction 4 Hours

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Module II Repercussions of Disasters and Hazards 4 Hours

Economic Damage, Loss of Humanand Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module III Disaster Prone Areas in India 4 Hours

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module IV Disaster Preparedness and Management 4 Hours

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module V Risk Assessment 4 Hours

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival.

Module VI Disaster Mitigation 4 Hours

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003AUDIT: SANSKRIT FOR TECHNICAL KNOWLEDGE

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNICAL KNOWLEDG**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS

Module I 8 Hours

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module II 8 Hours

Order, Introduction of roots, Technical information about Sanskrit Literature

Module III 8 Hours

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output
Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004AUDIT: VALUE EDUCATION

P18ACBA004	AUDIT : VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS

Module I **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles.Valuejudgments.

Module II **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module III **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

Module IV **6 Hours**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

Suggested reading

Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005AUDIT: CONSTITUTION OF INDIA

P18ACLW005	AUDIT: CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS

Module I History of Making of the Indian Constitution **4 Hours**

History Drafting Committee, (Composition& Working)

Module II Philosophy of the Indian Constitution **4 Hours**

Preamble, Salient Features

Module III Contours of Constitutional Rights &Duties **4 Hours**

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.

ModuleIVOrgans of Governance **4 Hours**

Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,**

Executive**,** President**,** Governor**,** Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Module V Local Administration **4 Hours**

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

Module VI Election Commission **4 Hours**

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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006AUDIT: PEDAGOGY STUDIES

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS

Module I Introduction and Methodology **4 Hours**

Aims and rationale, Policy background, Conceptual framework and terminology Theories of

learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

Module II Thematic overview 2 Hours

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module III Evidence on the effectiveness of pedagogical 4 Hours

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV Professional development 4 Hours

Alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module V Research gaps and future directions 2 Hours

Researchdesign,Contexts,PedagogyTeachereducation**,** Curriculum and assessment, Dissemination and research impact.

Suggested reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
- ✓ Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- ✓ Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- ✓ Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
- ✓ Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- ✓ www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- ✓ What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

  What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007AUDIT: STRESS MANAGEMENT BY YOGA

P18ACYO007	**AUDIT : STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS

Module I **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

Module II: **8 Hours**

Yam and Niyam.Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module III **8 Hours**

Asan and Pranayam
i)Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

- 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also Improve efficiency

P18ACBA008AUDIT: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

P18ACBA008	**AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination

- To awaken wisdom in students

SYLLABUS

Module I **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module II

Approach to day to day work and duties. **8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module III **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Suggested reading

1. Srimad Bhagavad Gita, by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes: Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students.

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	PSO	PSO
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	
	CO2	3			3	2			1		2				3
	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

.

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	PSO	PSO
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)
									MC	

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 4th 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

-

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.

U18PEEE23	**Distributed generation and Micro grid**	**L**	**T**	**P**	**C**
	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 charactericts
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 CREDIT SYSTEM

(Applicable to the batches admitted from July 2018)

M.Tech – POWER SYSTEMS
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1.	P18PCPS101	PC	Power System Analysis	3	3	0	0	3
2.	P18PCPS102	PC	Power System Dynamics-I	3	3	0	0	3
3.		PE	Professional Elective - 1	3	3	0	0	3
4.		PE	Professional Elective - 2	3	3	0	0	3
5.	P18PRPS101	PR	Research Methodology for Electrical Engineers and IPR	2	2	0	0	2
6.		AC	Audit I	2	2	0	0	0
PRACTICAL								
7	P18PCPS1L1	PC	Power System Steady State Analysis Lab	4	0	0	4	2
8	P18PCPS1L2	PC	Power system Dynamics	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCPS201	PC	Digital Protection of Power System	3	3	0	0	3
2	P18PCPS202	PC	Power System Dynamics-II	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		AC	Audit II	2	2	0	0	0
PRACTICAL								
6	P18PCPS2L1	PC	Power System Protection Lab	4	0	0	4	2
7	P18PCPS2L2	PC	Advanced power system lab	4	0	0	4	2
8	P18PRPS2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRPS3P2	PR	Phase – I Dissertation	20	0	0	20	10
			Total	26	6	0	20	16

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRPS4P3	PR	Phase-II Dissertation	32	0	0	32	16
			Total	32	0	0	32	16

TOTAL CREDIT : 18+18+16+16= 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE - 1								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPS011	PE	Renewable Energy System	3	3	0	0	3
2	P18PEPS012	PE	High Power Converters	3	3	0	0	3
3	P18PEPS013	PE	Wind and Solar Systems	3	3	0	0	3
4	P18PEPS014	PE	Applied mathematics	3	3	0	0	3

PROFESSIONAL ELECTIVE - 2								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPS021	PE	Electrical Power Distribution System	3	3	0	0	3
2	P18PEPS022	PE	Optimization Technique in Power systems	3	3	0	0	3
3	P18PEPS023	PE	Pulse width modulation for PE Converters	3	3	0	0	3
4	P18PEPS024	PE	Electric and Hybrid Vehicles	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPS031	PE	Restructured Power Systems	3	3	0	0	3
2	P18PEPS032	PE	Smart Grid	3	3	0	0	3
3	P18PEPS033	PE	Dynamics of Electrical Machines	3	3	0	0	3
4	P18PEPS034	PE	Power Apparatus Design	3	3	0	0	3

PROFESSIONAL ELECTIVE - 4								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPS041	PE	Advanced Micro-Controller Based Systems	3	3	0	0	3
2	P18PEPS042	PE	SCADA System and Applications	3	3	0	0	3
3	P18PEPS043	PE	Power Quality	3	3	0	0	3
4	P18PEPS044	PE	Artificial Intelligent Techniques	3	3	0	0	3

PROFESSIONAL ELECTIVE - 5								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PEPS051	PE	Power System Transients	3	3	0	0	3
2	P18PEPS052	PE	FACTS and Custom Power Devices	3	3	0	0	3
3	P18PEPS053	PE	Industrial Load Modelling and Control	3	3	0	0	3
4	P18PEPS054	PE	Dynamics Of Linear Systems	3	3	0	0	3

OPEN ELECTIVE								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18OEBA001	OE	Business Analytics	3	3	0	0	3
2	P18OEME002	OE	Industrial Safety	3	3	0	0	3
3	P18OEMA003	OE	Operations Research	3	3	0	0	3
4	P18OEBA004	OE	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	OE	Composite Materials	3	3	0	0	3
6	P18OEEE006	OE	Waste to Energy	3	3	0	0	3

Audit I& Audit II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18ACEN001	AC	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	AC	Disaster Management	2	2	0	0	0
3	P18ACEN003	AC	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	AC	Value Education	2	2	0	0	0
5	P18ACLW005	AC	Constitution of India	2	2	0	0	0
6	P18ACBA006	AC	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	AC	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	AC	Personality Development through Life Enlightenment Skills	2	2	0	0	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**		
1	**Professional Core (PC)**	**10**	**10**			**20**	**29.41**
2	**Program Electives (PE)**	**6**	**6**	**3**		**15**	**22.05**
3	**Open Electives (OE)**			**3**		**3**	**4.41**
4	**Project+ Research methodology+seminar (PR)**	**2**	**2**	**10**	**16**	**30**	**44.12**
5	**Audit Course(AC)**	**0**	**0**				
	Total Credit	**18**	**18**	**16**	**16**	**68**	
	Total Contact Hour	**24**	**26**	**26**	**32**	**108**	

P18PCPS101	**POWER SYSTEM ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basics **Power System**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Student will be able to:

Study various methods of load flow and to analyze various types of faults, security, state estimation and stability in power system

SYLLABUS

Module 1:Load flow **7 hours**

Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects,AVR in load flow, handling of discrete variable in load flow.

Module 2:Fault Analysis **7 hours**

Fault Analysis: Simultaneous faults, open circuit faults, generalized method of fault analysis. - Analysis of balanced and unbalanced three phase faults – fault calculations – Short Circuit faults

Module 3: Security Analysis **8 hours**

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

Module4 :Power system Equivalents **8 hours**

Power System Equivalents: WARD REI.equivalents. Static network reduction Ward. REI (Radial, Equivalent, Independent). Dynamic network reduction. Heuristic approach. Modal analysis approach.

Module 5:State Estimation **8 hours**

State Estimation: power system state estimation- Sources of errors in measurement, Method of least squares, Virtual and Pseudo, Measurement, Observability, Tracking state estimation,WSL method, bad data correction.

Module 6:Voltage stability **7 hours**

Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.Formulation of optimal power flow-solution by Gradient method-Newton's method.

TEXT BOOK

- J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003
- A. R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson , 2000

REFERENCES

- L.P. Singh , "Advanced Power System Analysis and Dynamics", New Age International, 2006
- G.L. Kusic, "Computer aided power system analysis" ,Prentice Hall India, 1986
- A.J. Wood, " Power generation, operation and control" , John Wiley, 1994
- P.M. Anderson, "Faulted power system analysis" , IEEE Press , 1995

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To Understand the different methods of load flow study and its applications to power system.
CO2	To analyze faults and interpret the result for designing the circuit.
CO3	To analyze security and rank various contingencies according to their severity
CO4	To understand and analyze the Static network reduction and Dynamic network reduction
CO5	To understand and analyze the power system state estimations
CO6	To analyze the stability of the system and estimate closeness to voltage collapse and calculate PV curves using continuation power flow

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	PSO1	PSO2
2	CO1	H	H	H		H	H	
	CO2	H	H	H		H	H	
	CO3	H						H
	CO4	H	H			H	H	
	CO5	H		M				
	CO6	H						H
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
	P18PCPS101 POWER SYSTEM ANALYSIS	H	H	H		H	H	H

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS101 POWER SYSTEM ANALYSIS	H	H	H

P18PCPS102	POWER SYSTEM DYNAMICS-I	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basics **power system**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Student will be able to:

- Study of system dynamics and its physical interpretation
- Development of mathematical models for synchronous machine and induction motor

SYLLABUS

Module 1:Synchronous Machines **8 hours**

Synchronous Machines: Per unit systems, Park's Transformation (modified) Flux-linkage equations.

Module 2:Voltage and current equations **8 hours**

Voltage and current equations, Formulation of State-space equations, Equivalent circuit.

Module 3: Transient **7 hours**

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines.

Module4: Small signal model **8 hours**

Small signal model: Introduction to frequency model.

Module5: Excitation **8 hours**

Excitation systems and Philips-Heffronmodel, PSS Load modeling.

Module6: Induction Motors **6 hours**

Modeling of Induction Motors, Prime mover controllers.

TEXT BOOK

- P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
- J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997

REFERENCES

- P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
- E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002.

COURSE OUTCOMES (COs) Students will be able to:	
CO1	Understand the modeling of synchronous machine in details
CO2	To analyze Voltage and current equations and formulation of State-space equations
CO3	To develop dynamic modeling of a synchronous machine.
CO4	To develop a small signal model
CO5	Carry out stability analysis with and without power system stabilizer (PSS)
CO6	Understand the Induction Motorsmodeling in power 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H		H		H
	CO2	H	H				H	
	CO3	H		H				H
	CO4	H				H		
	CO5	H	H				H	
	CO6	H		H		H		H
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS102 POWER SYSTEM DYNAMICS-I	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	**P18PCPS102** POWER SYSTEM DYNAMICS-I	H		H		H		H

P18PRPS101	**RESEARCH METHODOLOGY FOR ELECTRICAL ENGINEERS AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Periods – 40	2	0	0	2
	Pre requisite– **Professional ethics**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Student will understand research problem formulation and Analyze research related information

SYLLABUS

Module 1: 8 hours

Meaning of research problem, Sources of research problem, CriteriaCharacteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Module 2: 6 hours

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Module 3: 6 hours

Effective technical writing, how to write report, Paper enveloping a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module 4: 8 hours

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Module 5: 8hours

Patent Rights: Scope of Patent Rights. Licensing and transfer oftechnology. Patent information and databases. Geographical Indications.

Module 6: 6hours

New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOK&REFERENCES

- Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
- Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
- Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
- Mayall, “Industrial Design”, McGraw Hill, 1992.
- Niebel, “Product Design”, McGraw Hill, 1974.
- Asimov, “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”,2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To analyze the scope and objective of research problems.
CO2	Understand the effective literature studies approaches, analysis Plagiarism, and research ethics,
CO3	Get skill for effective technical writing to format the research proposal.
CO4	Understand the process of Patenting and Development
CO5	Understand the scope of Patent Rights, Licensing and transfer oftechnology
CO6	To Understand the new Developments in IPR

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	PSO1	PSO2
2	CO1				L		L	
	CO2				L		L	
	CO3				L		L	
	CO4				L		L	
	CO5						L	
	CO6						L	
3	Category	RESEARCH PROJECT						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PRPS101 RESEARCH METHODOLOGY FOR ELECTRICAL ENGINEERS AND IPR	H	M	

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PRPS101** RESEARCH METHODOLOGY FOR ELECTRICAL ENGINEERS AND IPR				M	H	-	L

P18PCPS1L1	**POWER SYSTEM STEADY STATE ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Basics Power System				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

- To allow students to practically verify several concepts and procedures learned in power system modeling and analysis.
- To carry out system studies using state of the art power systems analysis software to assess system operation in steady state and under faulted conditions.

LIST OF EXPERIMENTS

1. Mat lab program to solve load flow studies
2. Mat lab program to find optimum loading of generators
3. Simulink model for two area load frequency control
4. Transient stability analysis
5. Short circuit analysis using mat lab program
6. load frequency dynamics of single area bus system
7. Load frequency dynamics of two area bus system
8. analysis of transmission line parameters
9. Study of complete protection scheme for generator
10. Study of complete protection scheme for transformer.

COURSE OUTCOMES (COs) Students will be able	
CO1	obtain practical knowledge of LOAD FLOW STUDIES
CO2	Obtain practical knowledge of Transient Stability analysis
CO3	Obtain practical knowledge of Load Frequency Dynamics of Single Area Bus and Two Area Bus System
CO4	Gain practical information of Complete protection scheme for Generator
CO5	Gain practical information of Complete protection scheme for Transformer

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	PSO1	PSO2
2	CO1	H	H	M	L	L	H	L
	CO2	H	H	M	L	L	H	L
	CO3	H	H	M	L	L	H	L
	CO4	H	H	M	L	L	H	L
	CO5	H	H	M	L	L	M	L
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO 3	PO4	PO5	PSO1	PSO2
2	P18PCPS1L1 Power System Steady State Analysis Lab	H	H	H	L	H	M	L

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS1L1 Power System Steady State Analysis Lab	H	L	

P18PCPS1L2	**POWER SYSTEM DYNAMICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite – Basics of Power systems				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES: To gain practical knowledge on transient analysis of synchronous machine, two-bus system, Harmonic Analysis, excitation systems along with case study.

LIST OF EXPERIMENTS

1. Transient analysis of synchronous machine
2. Transient analysis of two-bus system.
3. Small-signal stability analysis of single machine-infinite bus system using classical machine model
4. Induction motor starting analysis
5. Harmonic Analysis of a Three-Phase Rectifier
6. Simulation and analysis of excitation systems
7. Case study 1
8. Case study -2

COURSE OUTCOMES (COs) Students will be able	
CO1	To carryout experimental and analyze Transient of synchronous machine and two-bus system.
CO2	To analyse the Small-signal stability analysis of single machine-infinite bus system
CO3	Students will be able to understand the analysis of Induction motor at starting
CO4	To understand and analyse Harmonic of a Three-Phase Rectifier
CO5	To carryout case study on dynamics analysis.

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO 3	PO4	PO5	PSO1	PSO2
2	**P18PCPS1L2** Power System Dynamics lab	H	H	H	L	H	M	L

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	PSO1	PSO2
2	CO1	H	H	M	L	L	H	L
	CO2	H	H	M	L	L	H	L
	CO3	H	H	M	L	L	H	L
	CO4	H	H	M	L	L	H	L
	CO5	H	H	M	L	L	M	L
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

COURSE	PEO1	PEO2	PEO3
P18PCPS1L2 Power System Dynamics lab	M	H	H

SEMESTER 2

P18PCPS201	**DIGITAL PROTECTION OF POWER SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System protection and switchgear				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To get an overall idea of different types of static relays and its applications, and about the modern digital techniques used in power system protection.

SYLLABUS

Module 1: **9 hours**

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection. Hardware and software for the measurement of voltage, current, frequency and phase angle for digital protection

Module 2: **9 hours**

Mathematical background to protection algorithms: Finite difference techniques, Interpolation formulas: forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

Module 3: **9 hours**

Digital Protection of power system apparatus –protection of generators – Transformer protection – magnetizing inrush current – Application and connection of transformer differential relays – transformer over current protection. Bus bar protection, line protection, distance protection–long EHV line protection, Power line carrier protection

Module 4: **9 hours**

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital,conversion,Digital filtering concepts.

Module 5: **9 hours**

The digital relay as a unit consisting of hardware and software. Recent Advances in Digital Protection of Power Systems. Testing Digital of protection relays – digital data transmission - Concepts of modern coordinated control system

TEXT BOOK

1. Chakrabarti,M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", DhanpatRai and Co.
2. Paithankar.Y.G and Bhide.S.R, "Fundamentals of Power System Protection", Prentice-Hall of India. Badri Ram and Vishwakarma.
3. D.N, "Power System Protection and Switchgear", Tata McGraw- Hill Publishing Company, 2002.
4. Arun K. Phadke, James. S. Thorp, "Computer relaying for Power system", John Wiley and sons, New York, 1998**.**

REFERENCES

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006S.R.Bhide "Digital Power System Protection" PHI Learning Pvt.Ltd.2014

COURSE OUTCOMES (COs)	
CO1	To Study the basic concept of digital protections and components
CO2	To analyze the mathematical back ground of protection algorithm.
CO3	To understand the concept of various protection systems for Generator, Transformer and substations.
CO4	Developing knowledge of digital hardware components for digital protection schemes.
CO5	Study of the advancements and testing of digital protection.

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	PSO1	PSO2
2	CO1	H					L	
	CO2	H					M	L
	CO3	H				M	H	L
	CO4	H		H			H	
	CO5	H					H	
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS201 DIGITAL PROTECTION OF POWER SYSTEM	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1		PO1	PO2	PO3	PO4	PO5
2	**P18PCPS201** DIGITAL PROTECTION OF POWER SYSTEM	H		H		M

	POWER SYSTEM DYNAMICS -II	L	T	P	C
	Total Contact Hours – 45	3	0	0	3

P18PCPS202	Prerequisite – **Power System Dynamics -I**
	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES: The objective of the course is to provide an understanding of the advanced concept of dynamics and stability theory as applied to power system.

SYLLABUS

Module 1: **8 hours**

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of unregulated and Regulated System.

Module 2: **7 hours**

Effect of Damper, Flux Linkage Variation and AVR.

Module 3: **7 hours**

Large Signal Rotor Angle Stability, Dynamic Equivalents And Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer.

Module 4: **8 hours**

Asynchronous Operation and Re-synchronization, Multi-Machine Stability.

Module 5: **8 hours**

Dynamic analysis of Voltage Stability, Voltage Collapse: Introduction to Voltage Stability; Factors affecting voltage instability and collapse; Comparison of Angle and Voltage Stability; Analysis of Voltage Instability and Collapse; Integrated Analysis of Voltage and Angle Stability; Control of Voltage Instability

Module 6: **7 hours**

Frequency Stability, Automatic Generation Control, Primary and Secondary Control, SubSynchronous Resonance and Counter Measures.

TEXT BOOK

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.

REFERENCES

1. J. Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
2. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007.
3. V. Ajjarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006.

COURSE OUTCOMES (COs)

CO1	Study of power system dynamics and stability methods.
CO2	To study the concept of Automatic Voltage Regulator and various voltage regulation methods.
CO3	Interpretation of power system dynamic phenomena.
CO4	To study the Asynchronous Operation and Re-synchronization, Multi-Machine Stability.
CO5	Understand the problem of factors affecting voltage instability and collapse.
CO6	Understand the methods to improve stability and automatic Generation 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H		H		H
	CO2	H	H				H	
	CO3	H		H				H
	CO4	H				H		
	CO5	H	H				H	
	CO6	H		H		H		H
3	Category	PROFESSIONAL CORE COURSE (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS202 POWER SYSTEM DYNAMICS-II	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	**P18PCPS202** POWER SYSTEM DYNAMICS -II	H		H		H		H

	POWER SYSTEM PROTECTION LABORATORY	**L**	**T**	**P**	**C**

P18PCPS2L1	Total Contact Hours – 40	0	0	4	2
	Prerequisite - **Power system dynamics I**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To gain knowledge of Protection system of Transformer, Generator & Substations.

SYLLABUS

1. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
2. Testing on (i) on load Time Delay Relay (ii) off load Time Delay Relay
3. Study of Different Characteristics of Over Current Relay
4. Impact of Induction Motor Starting on Power System
5. Study of Transformer Protection by Simulation
6. Study of Generator Protection by Simulation
7. Study of Substation Protection by simulation
8. Modeling of Differential Relay using MATLAB
9. Simulation of Radial Feeder Protection
10. Simulation of Parallel Feeder Protection
11. Simulation of Principle of Reverse Power Protection

COURSE OUTCOMES (COs)	
CO1	To gain testing knowledge on relays and its characteristics
CO2	To understand and Study of Transformer Protection by Simulation
CO3	To understand and Study of Generator Protection by Simulation
CO4	To understand and Study of Substation Protection by simulation
CO5	To study Simulation of Radial Feeder and Parallel Feeder Protection

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/SOs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		M		H
	CO2	H	H	H		M		H
	CO3	H	H	H		M		H
	CO4	H	H	H		M		H
	CO5	H	H	H		M		H
3	Category	Program Core Course(PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS2L1 POWER SYSTEM PROTECTION LABORATORY	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPS2L1** POWER SYSTEM PROTECTION LABORATORY	H	H	H		M		H

	ADVANCED POWER SYSTEM LABORATORY	**L**	**T**	**P**	**C**

P18PCPS2L2	Total Contact Hours – 40	0	0	4	2
	Prerequisite - Power system analysis				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES To gain knowledge and simulation ofLoad Dispatch control systemMicro & Smart Grid Control System, Substation controls system and Load shedding control analysis

SYLLABUS

1. Coordination of Power Plants and Power system Control
2. Simulation of Load Dispatch control system
3. Simulation of Micro Grid Control System
4. Simulation of Smart Grid control System
5. Simulation of Substation controls system
6. Load shedding control analysis

COURSE OUTCOMES (COs)	
CO1	To gain knowledge on Power Plants and Power system Control
CO2	To understand Load Dispatch control system
CO3	To understand and simulate Micro Grid Control System
CO4	To understand andsimulate Smart Grid control System
CO5	To study Simulation of Substation controls system

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

1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		M		H
	CO2	H	H	H		M		H
	CO3	H	H	H		M		H
	CO4	H	H	H		M		H
	CO5	H	H	H		M		H
3	Category	Program Core Course (PCC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PCPS2L2 ADVANCED POWER SYSTEM LABORATORY	H	H	H

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

COURSE OUTCOMES (COs)	
CO1	Understand and analyze the literature survey of Power System.
CO2	To understand and analyze the design concepts of Power System
CO3	To understand the applications of Power System Components.
CO4	To design and implement mini projects related to Power System components

1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PCPS2L2**ADVANCED POWER SYSTEM LABORATORY	H	H	H		M		H

P18PRPS2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 40	3	0	0	3
	Prerequisite – Technical seminar				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- The purpose of technical seminar is to train the students in preparing and presenting technical topics.
- The students are expected to give a presentation on their topics of interest which will be assessed by a Faculty in charge, for this purpose during the current semester as per the academic regulations.
- The student shall be capable of identify design, fabricate mini projects of power electronic components

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/SOs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1		H	H	M	M	M	M
	CO2		H	H	M	M	M	M

	CO3		H	H	M	M	M	M
	CO4		H	H	M	M	M	M
3	Category	Project(PR)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PRPS2P1 MINI PROJECT WITH SEMINAR	H	H	

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PRPS2P1** MINI PROJECT WITH SEMINAR		H	H	M	M	M	M

PROFESSIONAL ELECTIVE – 1

P18PEPS011	**RENEWABLE ENERGY SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –**Power Systems**.				

	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES:

Students will be able to learn various renewable energy sources and understanding of integrated operation of renewable energy sources, Interface with the Grid.

SYLLABUS

Module 1: **9 hours**

Introduction: Current energy requirements, growth in future energy requirements, Review of conventional energy resources- Coal, gas and oil reserves and resources, Tar sands and OilShale, Nuclear energy Option.

Module 2: **9 hours**

Solar Energy: Solar radiation: measurements and prediction. Solar thermal collectors- flat plate collectors, concentrating collectors. Basic theory of flat plate collectors, solar heating of Buildings, solar still, solar water heaters, solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

Module 3: **9 hours**

Wind Energy: Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, andApplications.

Module 4: **9 hours**

Ocean Energy: Ocean energy resources-ocean energy routes - Principles of ocean thermalenergy conversion systems- ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion

Module 5: **9 hours**

Other Sources: Hydropower, Nuclear fission and fusion-Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

TEXTBOOK

1. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000.
2. C. S. Solanki, "Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall of India, 2009.

REFERENCES

1. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
2. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.
3. S.P. Sukhatme, Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-

COURSE OUTCOMES (COs)	
CO1	To Understand about the energy requirements and resources.
CO2	To Understand and gain knowledge on basics of solar energy and applications.

CO3	To Understand about the wind energy and its applications.
CO4	To Understand the principles of ocean energy and tidal energy.
CO5	To gain fair knowledge about other renewable energy sources.

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	PSO1	PSO2
2	CO1	M	H	M	L	L	M	M
	CO2	M	H	H	L	L	M	M
	CO3	M	M	M	L	M	M	M
	CO4	M	H	H	L	L	M	M
	CO5	M	M	M	L	M	L	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program outcomes (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low				
1		PEO1	PEO2	PEO3
2	**P18PEPS011** RENEWABLE ENERGY SYSTEM	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS011** RENEWABLE ENERGY SYSTEM	H	H	H	L	H	M	L

P18PEPS012	**HIGH POWER CONVERTERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 40	3	0	0	3
	Prerequisite – Power Electronics				
	Course Designed by – Dept. of Electrical & Electronics Engineering / AICTE				

OBJECTIVES

Students will be able to understand the requirements of high power rated converters, different topologies involved for these converters and also to understand the design of protection circuits for these converters.

SYLLABUS

Module 1: **6 Hours**

Power electronic systems, an overview of PSDs, multipulse diode rectifier, multipulseSCR rectifier.

Module 2: **8 Hours**

Phase shifting transformers, multilevel voltage source inverters: twoLevel voltage source inverter, cascaded H bridge multilevel inverter

Module 3: **6 Hours**

Diode clamped multilevel inverters, flying capacitor multilevel inverter

Module 4: **6 Hours**

PWM current source inverters, DC to DC switch mode converters

Module5: **8 Hours**

AC voltage controllers: Cyclo-converters, matrix converter, Power conditioners and UPS.

Module6: **6 Hours**

Design aspects of converters, protection of devices and circuits

TEXT BOOK

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”,
2. John Wiley and Sons, 1989

REFERENCES

1. M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994
2. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986
3. Bin Wu, “High power converters and drives”, IEEE press, Wiley Enter science

COURSE OUTCOMES (COs)

P18PEPS013	WIND AND SOLAR SYSTEMS	L	T	P	C

CO1	To understand the basics of Rectifiers with diodes and SCR's.
CO2	To Understand the Operation of Inverters and Multilevel Inverters.
CO3	To Understand the working of diode clamped and flying capacitor Multilevel Inverter.
CO4	To Understand PWM CSI and DC to DC Converters.
CO5	To Understand the working of Ac Voltage Controllers and UPS.
CO6	To Understand the design and protection of converters and 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	M		M	M	M
	CO2	H	H	M	L	M	M	H
	CO3	M	M	M	M	M	M	M
	CO4	H	H	M	L	M	M	H
	CO5	H	H	M	L	M	M	H
	CO6	M	M	M	M	M	M	H
	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
P18PEPS012 HIGH POWER CONVERTERS	H	H	L

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

1		PO1	PO2	PO3	PO4	PO5
2	**P18PEPS012** HIGH POWER CONVERTERS	H	H	H	L	L

	Total Contact Hours – 44	3	0	0	3
	Prerequisite – Renewable energy				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- Students will be able to get exposure to wind and solar systems
- To understand the factors involved in installation and commissioning of a Solar or Wind plant.
- Learning the dynamics involved when interconnected with power system grid

SYLLABUS

Module 1: **8 Hours**

Historical development and current status- characteristics of wind power generation- network integration issues

Module 2: **8 Hours**

Generators and power electronics for wind turbines- power quality standards for wind turbines- Technical regulations for interconnections of wind farm with power systems.

Module 3: **8 Hours**

Isolated wind systems, reactive power and voltage control- economic aspects

Module 4: **8 Hours**

Impacts on power system dynamics- power system interconnection.

Module 5: **8 Hours**

Introduction of solar systems- merits and demerits, concentrators, various applications- Solar thermal power generation- PV power generation- Energy Storage device- Designing the solar system for small installations.

Text/References:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996

COURSE OUTCOMES (COs)	
CO1	To gain knowledge of the characteristics of wind power generation- network integration issues
CO2	To know the power quality standards for wind turbines and technical regulations for interconnections of wind farm with power systems.
CO3	To study about economic aspects based on wind energy systems and reactive control
CO4	To gain knowledge of the impacts on power system dynamics and power system interconnection
CO5	Demonstrate the knowledge of design aspect of solar power generation and the associated issues

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	PSO1	PSO2
2	CO1	H		H			M	--

	CO2	H		H		M	M	--
	CO3	H		H			M	--
	CO4	H	H	H	H	M	M	--
	CO5	H		H	H		M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS013 WIND AND SOLAR SYSTEMS	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS013** WIND AND SOLAR SYSTEMS	H	H	L			M	-

P18 PEPS 014	**APPLIED MATHEMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Nil				
	Course Designed by – Department of Mathematics				

OBJECTIVES

To know the basic concepts of advance matrices, calculus of variation,Probability concepts andRandom Processtechnique.

SYLLABUS

Module 1:Advanced matrix theory **12Hours**

Eigen values using QR transformations generalized eigenvectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

Module 2:Calculus of variations **12 Hours**

Variation and its properties– Euler's Equation –Functional dependent on first andhigher order derivatives – functional dependent on functions of several independent variables – constraints in the form of a functional isoperimetric problems – Direct method – Ritz and Kantorovich methods – Boundary value problems.

COURSE OUTCOMES (COs)	
CO1	Learn to manipulate matrices and to do matrix algebra, determinants, Eigen values,Eigen vectors and to solve the system of linear equations
CO2	Learn to analyze the concept of Variation and its properties
CO3	Learn to understand special functions like Bessel functions – Recurrence relations generating functions and orthogonal of Bessel's functions etc
CO4	Apply concepts of Probability to solve problems in Engineering sciences
CO5	To know about several Random Process Techniques.

Module 3: Special Functions **12 Hours**

Series solutions – Bessel's equations – Bessel functions – Recurrence relations generating functions and orthogonal of Bessel's functions of the first kind Legendary's equations, Legendary polynomials – Rodriguez's formula applications to boundary value problems

Module 4: Probability **12 Hours**

Probability concepts – Random variables Discrete and continuous dissimulations Correlations partial, multiple, rank analysis of variance one way, two way process.

Module 5:Random process **12 Hours**

Poisson process Gaussian process Markov process-Anti Correlations-Cross correlations – Queuing models – quality control – control charts – tolerance limits.

Total No. of Periods: 60

REFERENCES:

1. Sankar Rao K: "Introduction to Partial Differential Equations" – Prentice Hall of India, New Delhi 1995.
2. Elsgoth, "Differential Equations and Calculus of Variations" MIR Publishers, Moscow.
3. Grewal B.S. "Higher Engineering Mathematics, Khanna Publications, New Delhi 1989.
4. Androws L.A. "Special Function of Scientist and Engineers"
5. Venkataramn M.K. "higher engineering mathematics, the National Publishing Company, 1990.
6. Narayanan S. Manicasachagam Pillai and Ramaniah G. "Advanced Mathematics for Engineering Students" Vol II and ill, Viswanathan printers Pvt. Ltd., Madras1 1985.
7. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi 1994.
8. Gupta and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.

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	PSO1	PSO2
2	CO1	H		H		L	H	M
	CO2						H	M
	CO3			H		L	H	M
	CO4						H	M
	CO5					H	H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	**PEO1**	**PEO2**	**PEO3**
P18 PEPS 014 APPLIED MATHEMATICS	H	H	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1.		PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2
2.	**P18 PEPS014 101** APPLIED MATHEMATICS	M		H		M	H	M

OBJECTIVES

Student will gain concept and understand the Power distribution system, SCADA System and Automated Distribution Systems.

SYLLABUS

Module 1: **8Hours**

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

P18PEPS021	**ELECTRIC POWER DISTRIBUTION SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – **Power System**				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module 2: **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

Module 3: **8 Hours**

Interconnection of Distribution, Control& Communication Systems, Remote Metering, Automatic Meter Reading and its implementation

Module 4: **8 Hours**

SCADA: Introduction, Block Diagram,SCADA Applied To Distribution Automation. Common Functions of SCADA,Advantages of Distribution Automation through SCADA

Module 5: **7 Hours**

Calculation of Optimum Number of Switches, Capacitors, OptimumSwitching Device Placement in

Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits,Bellman's Optimality Principle,Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

Module 6: **6 Hours**

Maintenance of Automated Distribution SystemsDifficulties 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. James Momoh, "Electric Power Distribution, automation, protection & control".

COURSE OUTCOMES (COs) Students will be able to:	
CO1	Knowledge of power distribution system
CO2	Understand the concept of Distribution Management System
CO3	Understand the Control & Communication Systems
CO4	learn the SCADA system
CO5	learn the OptimumSwitching Device Placement
CO6	Study of Distribution automation and its application in practice

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	PSO1	PSO2
2	CO1	H		H		H		H
	CO2					H		H
	CO3	H				H	H	
	CO4		H			H		H
	CO5					H		H
	CO6	H						H
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS021 ELECTRIC POWER DISTRIBUTION SYSTEM	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS021** ELECTRIC POWER DISTRIBUTION SYSTEM	H	H	H	M	H	H	H

P18PEPS022	**Optimization Techniques in Power System**	**L**	**T**	**P**	**C**
	Total Contact Hours – 42	3	0	0	3
	Prerequisite – Power System Analysis				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To gain knowledge of optimization techniques applied to power systems in order to achieve technical and economic efficiency.

SYLLABUS

Module 1: Fundamentals of optimization techniques 9 Hours

Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Lamda Iteration method, linear programming, Quadratic programming). Concept of Particle Swarm Optimization and Genetic Algorithm

Module 2: Optimal Power System Operation & Control 9 Hours

Optimal Operation of generators on a bus bar, Optimal spinning reserve, Introduction Load Frequency Control, Turbine Speed Governing System, Generator Load Model, Optimal Load frequency control and Economic Dispatch Control, Automatic Voltage Control, optimal Generation Control.

Module 3: Optimal Load Dispatch of Generating Units 9 Hours

Optimal Economic Dispatch problem on a bus bar, optimal generation scheduling, Economic dispatch using Newton-Raphson method- Concept of State, Regional and Central Load dispatch center-Responsibilities and functions of State Load Dispatch Centre.

Module 4: Multi-Objective Optimal Generation Scheduling 9 Hours

Multi objective optimization- State of the art, Fuzzy set theory in power system, State Load Dispatch Centre. Concept of State, Regional and Central Load dispatch center.multi objective thermal power dispatch problem, multi objective dispatch for active & reactive power balance. Introduction, multi-objective stochastic optimal thermal power dispatch.

Module 5: Application of optimization techniques in power systems 9 Hours

Algorithms and flow chart of various optimization techniques for solving economic load dispatch in

Smart Grid and Micro Grid system. Optimal utilization of renewable energy resources in Smart grid environment. Application of artificial intelligent techniques in power systems optimization.

Text/Reference Books

1. Kothari D.P, Dhillon J.S, "Power System Optimization" – PHI Private Limited. 2010
2. JJames A Momoh, "Electric Power System Application of Optimization", CRC Press2001
3. S.S. Rao, "Engineering Optimization-Theory and Practice Power", 2009 John Willey &Sons, New York, USA.
4. A.D. Belegundu, T.R. Chandrupatla, "Optimization Concepts and Applications in Engineering", Cambridge, University press 2011
5. Haoyong Chen, Yongjun Zhang, Honwing Ngan." Power System Optimization: Large-scale
6. Complex Systems Approaches"Publisher: Wiley, Edition: 1, 2016

COURSE OUTCOMES (COs)	
CO1	To understand the fundamental concepts of economic optimization techniques
CO2	To get knowledge of Power system controls and optimization techniques like Optimal Load frequency control and Economic Dispatch Control, Automatic Voltage Control, optimal Generation Control etc
CO3	To understand the concepts of economic load dispatch and to gain knowledge of Concept of State, Regional and Central Load dispatch center and its functions
CO4	To understand the multi-objective optimization methods in power system problem solving.
CO5	To learn the different classical and intelligent optimization techniques in power 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H				M	M	
	CO2	M				M	M	H
	CO3					M	M	H
	CO4					M	M	H
	CO5					M	M	H
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS022 OPTIMIZATION TECHNIQUES IN	M	M	

POWER SYSTEM			

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS022** OPTIMIZATION TECHNIQUES IN POWER SYSTEM					M	M	H

P18PEPS023	**PULSE WIDTH MODULATION FOR PE CONVERTERS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – power electronics				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To understand necessity and Importance of PWM techniques and implementation of PWM controllers

SYLLABUS

Module 1: **8 hours**

Introduction to PE converters, Modulation of one inverter phase leg, Modulation of single phase, VSI and 3 phase VSI

Module 2: **8 hours**

Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI

Module 3: **8 hours**

Over modulation of converters,programme modulation strategies.

Module 4: **9 hours**

Pulse width modulation for multilevel inverters, Implementation of modulation controller.

Module 5: **12 hours**

Continuing developments in modulation as random PWM, PWM for voltage unbalanceEffect of minimum pulse width and dead time

TEXT BOOK / REFERENCES:

1. D. Grahame Holmes, Thomas A. Lipo, “Pulse width modulation of Power Converter: Principles and Practice”, John Wiley & Sons, 03-Oct-2003
2. Bin Vew, “High Power Converter”, Wiley Publication
3. Marian K. Kazimicrczuk, “Pulse width modulated dc-dc power converter”, Wiley Publication.

COURSE OUTCOMES (COs)	
CO1	To understand the concept of Introduction to PE converters and Voltage Source Inverter

CO2	To understand the concept of Current Source Inverter.

P18PEPS024	**ELECTRIC AND HYBRID VEHICLES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3

CO3	To gain the knowledge of Over Modulation.
CO4	To learn more about Pulse Width Modulation for multilevel inverters
CO5	Compare performance of converter for different PWM techniques

Mapping of Course Outcomes with Program outcomes (SOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M	H	H		M	H	
	CO2	M	H	H		M	H	
	CO3	M	H	H		M	H	
	CO4	M	H	H		M	H	
	CO5	M	H	H		M	H	
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS023 PULSE WIDTH MODULATION FOR PE CONVERTERS	H	M	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS023** PULSE WIDTH MODULATION FOR PE CONVERTERS	M	H	H		M		

	Prerequisite – **Electric Drives**
	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES

- Students will be able to Understand upcoming technology of hybrid system
- To understand different aspects of drives application.
- To Learn the electric Traction

SYLLABUS

Module 1: **9 Hours**

History of hybrid and electric vehicles. Social and environmental importance of hybrid and electric Vehicles. Impact of modern drive-trains on energy supplies. Basics of vehicle performance. Vehicle power source characterization. Transmission characteristics. Mathematical models to describe vehicle performance

Module 2: **9 Hours**

Basic concept of hybrid traction. Introduction to various hybrid drive-train topologies. Power flow control in hybrid drive-train topologies. Fuel efficiency analysis.

Module 3: **9 Hours**

Basic concepts of electric traction. Introduction to various electric drive-train topologies. Power flow control in hybrid drive-train topologies. Fuel efficiency analysis

Module 4: **9 Hours**

Introduction to electric components used in hybrid and electricvehicles.Configuration and control of DC Motor drives. Configuration and control of Introduction Motor drives. Configuration and control of Permanent Magnet Motor drives. Configuration and control of Switch Reluctance Motor drives. Drive system efficiency.

Module 5: **9 Hours**

Matching the electric machine and the internal combustionengine (ICE). Sizing the propulsion motor. Sizing the power electronics. Selecting the energy storage technology. Communications. Supporting subsystems. Introduction to energy management and their strategies used inhybrid and electric vehicle. Classification of different energy management strategies. Comparison of different energy management strategies. Implementation issues of energy strategies.

TEXT BOOK:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.

2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003. Reference Books:

REFERENCES:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000

.http://nptel.ac.in/courses/108103009/

COURSE OUTCOMES (COs)	
CO1	To acquire knowledge about fundamental concepts of Electric and Hybrid vehicles
CO2	To acquire knowledge about fundamental concepts and principles of hybrid Traction.

CO3	To analyze and designhybrid and electric vehicles
CO4	To Learn about electric drives for Hybrid vehicles
CO5	To design and analyze support systems for Hybrid vehiclesand concept of Selecting the energy storage technology. Communications. Supporting 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H	H		M	--
	CO2	M		H	H		M	--
	CO3	M		H	H		M	--
	CO4	M		H	H		M	--
	CO5	H	H	H	H		M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS024 ELECTRIC AND HYBRID VEHICLES	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS024** ELECTRIC AND HYBRIDVEHICLES	H	H	L			M	-

PROFESSIONAL ELECTIVE - 3

P18PEPS031	**RESTRUCTUREDPOWER SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Power System analysis				

	Course Designed by – Department of Electrical & Electronics Engineering

OBJECTIVES

To study the complete process of deregulation and restructuring of Power Industry.

SYLLABUS

Module 1: **8 hours**

Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization.

Module 2: **8 hours**

OPF: Role in vertically integrated systems and in restructured markets, congestion management

Module 3: **8 hours**

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power.

Module 4: **8 hours**

Ancillary services, Standard market design, Distributed generation in restructured markets.

Module 5:

Development in India, IT applications in restructured markets. **7 hours**

Module 6: **6 hours**

Working of restructured power systems, PJM, Recent trends in Restructuring.

TEXT BOOK

1. Sally Hunt," Making competition work in electricity", , John Willey and Sons Inc. 2002
2. Steven Stoft," Power system economics: designing markets for electricity", John Wiley & Sons, 2002.
3. Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001

REFERENCES

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub, 1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub, 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

COURSE OUTCOMES (COs)	
CO1	To learn the issues involving in restructuring and deregulation of Power Network and to learn the various fundamentals of Electricity market and its functions.
CO2	To have understanding of integrating system and congestion management
CO3	To know the Selection of energy storage technology and Communications. Supporting subsystems.
CO4	To learn the standard market design and distributed generation in restructured

	markets
CO5	To learn IT applications in restructured markets
CO6	Understand the recent trends in restructured power 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M		H			H	M
	CO2			H		L	H	M
	CO3	M	M				H	M
	CO4	M		H			H	M
	CO5	M	L	H			H	M
	CO6	M		H			H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS031 RESTRUCTURED POWER SYSTEMS	H	L	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1		PO1	PO2	PO3	PO4	PO5
2	**P18PEPS031** RESTRUCTURED POWER SYSTEMS	M		H		

P18PEPS032	**SMART GRIDS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – **Renewable Energy**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

1. Understand concept of smart grid and its advantages over conventional grid.

2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its Solution through smart grid.

SYLLABUS

Module 1: 6 hours

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid

Module 2: 8 hours

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR),Outage Management System (OMS),Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home& Building Automation, Smart Substations, Substation Automation, Feeder Automation

Module 3: 6 hours

Geographic Information System (GIS),Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit(PMU).

Module 4: 8 hours

Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection& control of micro-grid, Plastic& Organic solar cells, thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

Module 5: 8 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

Module 6: 9 hours

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN),Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network. Basics of CLOUD Computing &Cyber Security for Smart Grid, Broadband over Power line (BPL). IP based protocols

TEXT BOOK

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications",Wiley 2012.
2. Stuart Borlas'e, "Smart Grid:Infrastructure, Technology and solutions "CRC Press.
3. A.G.Phadke , "Synchronized Phasor Measurement and their Applications

COURSE OUTCOMES (COs)	
CO1	Understand the difference between smart grid & conventional grid and concept of Smart Grid.
CO2	Understand various component of Smart Grid.
CO3	Understand Intelligent Electronic Devices (IED) hardware electronic components of Smart Grid, Smart storage like Battery, SMES, Pumped Hydro, etc.

CO4	Get Knowledge of need& applications of micro-grid, formation of micro-grid, Issues of interconnection, Protection& control.
CO5	Understanding the problems associated with issues of Grid connected Renewable Energy Sources,
CO6	To gain knowledge of modern communication network technologies of Smart Grid

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Sos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1						H	M
	CO2		M			M	H	M
	CO3					M	H	M
	CO4						H	M
	CO5		M			M	H	M
	CO6		M			M	H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS032 SMART GRIDS	H	M	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS032 SMART GRIDS**		M				H	M

P18PEPS033	**DYNAMICS OF ELECTRICAL MACHINES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Electrical Machines &Power System Dynamics				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To gain fundamental knowledge about Dynamics of Electrical machines and its characteristic

SYLLABUS

Module 1:Basic Primitive Machines **10 hours**

Stability- Primitive Winding Commutator Machine. Commutator Primitive Machine-Complete Voltage Equation of Primitive Winding Commutator

Module 2:DC Machines **10 hours**

Torque Equation. Analysis of Simple DC Machines using the Primitive Machine Equations- the Three Phase Induction Motor. Transformed Equations- Different Reference Frames for induction Motor Analysis Transfer Function Formulation

Module 3:Salient Pole Machine **6 hours**

Three Phase Salient Pole Synchronous Machine- Parks Transformation- Steady State Analysis

Module 4:Interconnected Machines **6hours**

Large Signal Transient. Small Oscillation Equations in State Variable form Dynamical Analysis of Interconnected Machines.

Module 5:Transformers **9 hours**

Large Signal Transient Analysis using Transformed Equations- DC Generator /DC Motor System.

Module 6:Synchronous Motor **4 hours**

Dynamic analyses of alternator /Synchronous Motor System.

TEXT BOOK

1. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company, 1987
2. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967\

REFERENCE

1. D.P. Sengupta& J.B. Lynn," Electrical Machine Dynamics", the Macmillan Press Ltd. 1980
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001.
3. I. Boldia& S.A. Nasar,"Electrical Machine Dynamics", the Macmillan Press Ltd. 1992

COURSE OUTCOMES (COs)	
CO1	To learn about the dynamics equation of Primitive machines.
CO2	To study the dynamics operation of Primitive DC Machines and transformers.
CO3	To analyze the Three Phase Salient Pole Synchronous Machine
CO4	To study about the dynamics analyses of interconnected machines.
CO5	To study about Large Signal Transient and Small Oscillation Equations in State Variable form Dynamical Analysis of Interconnected Machines.

CO6	To study about dynamic analyses of alternator /Synchronous Motor System.

	POWER APPARTUS DESIGN	**L**	**T**	**P**	**C**

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	PSO1	PSO2
2	CO1	M	L			H	M	L
	CO2	L	H			H	M	M
	CO3	M	H			H	H	H
	CO4	M	M			H	H	H
	CO5	L	H			H	M	M
	CO6	L	H			H	M	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS033 DYNAMICSOF ELECTRICAL MACHINES	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS033** DYNAMICS OFELECTRICAL MACHINES	H	H	L			H	M

P18PEPS034	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Electrical Machine Design				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- To gain knowledge of Principles of Design of Machines and transformers

SYLLABUS

Module 1: **8 HOURS**

Principles of Design of Machines -Specific loadings, choice of magneticand electric loadings, real and apparent flux densities, temperature rise calculation, Separationofmain dimension for DC machines,Induction machines and synchronous machines,Design of Transformers-General considerations, output equation, emfperturn, choice of flux density and current density, main dimensions, leakagereactance and conductor size, design of tank and cooling.

Module 2: **8 HOURS**

Specific loadings, choice of magnetic and electric loadings Real andapparent flux -densities, temperature rise calculation,Separation of main dimension for DC machines,Induction machines and synchronous machines,Heating and cooling of machines, types of ventilation, continuous and intermittent rating

Module 3: **8 HOURS**

General considerations, output equation,emfper turn, choice of fluxdensity and current density, main dimensions, leakage reactance andconductor size, design of tank and cooling tubes,Calculation of losses, efficiency and regulation

Module 4: **8 HOURS**

General considerations, output equation,Choice of specific electric and magnetic loadings, efficiency, power factor,Number of slots in stator and rotor,Elimination of harmonic torques.

Module 5: **6 HOURS**

Design of stator and rotor winding, slot leakage fluxLeakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data

Module 6: **7 HOURS**

Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions Introduction to Computer Aided Electrical Machine Design Energyefficient machines

TEXT BOOK/REFERENCES

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai& Sons, 5th Edition

COURSE OUTCOMES (COs) Students will be able to:	
CO1	To gain the knowledge about the principle of design of machines

CO2	An ability to understand design aspects of DC machines, Induction machines and synchronous machines, Heating and cooling of machines and types of ventilation.
CO3	To study the technical parameters of the machines ,output equation,emf per turn and calculation of loss
CO4	To understand output equation, choice of specific electric and magnetic loadings, efficiency, power factor and elimination of harmonic torques.
CO5	To gain knowledge about the design factors of squirrel cage rotor.
CO6	To understand the computer Aided Design of Electrical Machine.

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	PSO1	PSO2
2	CO1	H	H	H		H	H	
	CO2	H	H	H		H	H	
	CO3	H	H	H		H	H	
	CO4	H	H	H		H	H	
	CO5	H	H	H		H	H	
	CO6	H	H	H		H	H	
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS034 POWER APPARTUS DESIGN	H	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS034** POWER APPARTUS DESIGN	H	H	H		H	H	

PROFESSIONAL ELECTIVE – 4

P18PEPS041	ADVANCED MICRO-CONTROLLER BASED SYSTEMS	L	T	P	C
	Total Contact Hours – 44	3	0	0	3
	Prerequisite – Digital Electronics				
	Course Designed by – Department of Electrical & Electronics Engineering				

- **OBJECTIVES** To understand the architecture of advance microcontrollers and FPGA, the applications of micro controllers.

SYLLABUS

Module 1 **8 Hours**

Basic Computer Organization,Accumulator based Processes-Architecture Memory Organization-I/O Organization

Module 2 **8 Hours**

Micro-Controllers-Intel 8051, Intel 8056-Registers, Memories I/O Ports,Serial Communication Timers, Interrupts, Programming

Module 3 **8 Hours**

Intel 8051 – Assembly language programming Addressing-OperationsStack& Subroutines Interrupts-DMA

Module 4 **8 Hours**

PIC 16F877- Architecture Programming Interfacing Memory/ I/O DevicesSerial I/O and data communication

Module 5 **7 Hours**

Digital Signal Processor (DSP) Architecture – Programming Introduction to FPGA

Module 6 **6 Hours**

Microcontroller development for motor control applications Stepper motor control using micro controller

TEXT BOOK

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
3. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005

REFERENCES

1. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
2. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18FSeries", Elsevier, 2008Microchip datasheets for PIC16F877

COURSE OUTCOMES (COs)	
CO1	To Understand the architecture of Basic Computer Organization
CO2	To Understand the Interrupts, Registers and Communication Ports of 8051
CO3	To Study about the Addressing Modes of 8051
CO4	To Understand the architecture of PIC 16F877

CO5	To Understand the basic of DSP and FPGA
CO6	To Study the Applications of Microcontroller.

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	PSO1	PSO2
2	CO1	M	M	M	H	M	H	M
	CO2	M	M	M	H	M	H	M
	CO3		M	H	H	H	H	M
	CO4		M	H	H	H	H	M
	CO5	M	M	M	H	M	H	M
	CO6			L	H		H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS041ADVANCED MICRO-CONTROLLER BASED SYSTEMS	M	M	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS041** ADVANCED MICRO-CONTROLLER BASED SYSTEMS	M	M	M	H	M	H	M

P18PEPS042	**SCADA SYSTEM AND APPLICATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – **Control System**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

To understand the operation, communication, functions and applications of SCADA.

SYLLABUS

Module 1: 8 Hours

Introduction to SCADA-Data acquisition systems-Evolution of SCADA-Communication technologies.

Module 2: 7 Hours

Monitoring and supervisory functions-SCADA applications in Utility Automation-Industries SCADA.

Module 3: 8 Hours

Industries SCADA System Components-Schemes- Remote Terminal Unit (RTU)-Intelligent Electronic Devices (IED)-Programmable Logic Controller (PLC)-Communication Network, SCADA Server, SCADA/HMI Systems

Module 4: 8 Hours

SCADA Architecture-Various SCADA architectures, advantages and disadvantages of each system-single unified standard architecture -IEC 61850.

Module 5: 8 Hours

SCADA Communication- various industrialcommunication technologies-wired and wireless methods and fiber optics-Open standard communication protocols.

Module 6: 6 Hours

SCADA Applications: Utility applications-Transmission and Distribution sector operations, monitoring, analysis and Improvement- Industries- Oil, gas and Water.

TEXT BOOKS

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of AmericaPublications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems", Newnes Publications, Oxford, UK,2004.

Reference Books

1. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 200
3. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power",PennWell 1999.

COURSE OUTCOMES (COs)	
CO1	To Understand the basics of SCADA.
CO2	To study the supervisory functions of SCADA.
CO3	To study about the components of SCADA and HMI system.
CO4	To Understand the architecture of SCADA and IEC 61850.

CO5	To Understand the Communication Technologies in SCADA.
CO6	To Study the applications of SCADA for 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H				H	H	M
	CO2	H	M		H	H	H	M
	CO3	H	M		H	H	H	M
	CO4	H				H	H	M
	CO5	H				H	H	M
	CO6	H			H	H	H	M
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS042 SCADA SYSTEM AND APPLICATIONS	M	H	H

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS042** **SCADA SYSTEM AND APPLICATIONS**	H			H	H	H	M

OBJECTIVES

Students will be able to understand the overview of **power quality** phenomena and classification of power quality issues.

P18PEPS043	**POWER QUALITY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – **Power system**				
	Course Designed by – Department of Electrical & Electronics Engineering				

SYLLABUS

Module 1: **5 hours**

Introduction-power quality-voltage quality-overview of powerQuality phenomena classification of power quality issues.Quality phenomena classification of power quality issues.Power quality measures and standards-THD-TIF-DIN-C-message weights.Flicker factor transient phenomena-

occurrence of power quality problemsPower acceptability curves-IEEE guidesStandards and recommended practices.

Module 2: **8 hours**

Harmonics-individual and total harmonic distortionRMS value of a harmonic waveformTriplex harmonics. Important harmonic introducing devices.SMPSThree phase power converters-arcing devices saturabledevicesHarmonic distortion of fluorescent lamps-effect of power system harmonicson power system equipment and loads.

Module 3: **6 hours**

Modeling of networks and components under non-sinusoidal conditionsTransmission and distribution systemsShunt capacitors-transformers.Electricmachines.Ground systems loads that cause power quality problems.Ground systems loads that cause power quality problems.Power quality problems created by drives and its impact on drive.

Module 4: **6 hours**

Power factor improvement- Passive Compensation. PassiveFiltering. HarmonicResonance. Impedance Scan AnalysisPower Factor Corrected Single Phase Front EndControl Methods for Single Phase APFC.Three Phase APFC and Control TechniquesPFC based on Bilateral Single Phase and Three Phase Converter.

Module 5: **6 hours**

Hamilton-Jacobi-Bellman equation - model reference adaptivesystemsIntroduction to design method based on the use of Liapunovfunction(MRAS) - Design hypothesis.Design and simulation of variable structure adaptive model control.

TEXT BOOKS /REFERENCES:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power system Harmonic Analysis”, Wiley,1997

COURSE OUTCOMES (COs)	
CO1	Introduction-power quality-voltage quality-overview of powerQuality phenomena classification of power quality issues.
CO2	To develop analytical modeling skills needed for modeling and analysis of harmonics innetworks and components.
CO3	To introduce the student to active power factor correction based on static VAR compensators andits control techniques
CO4	To introduce the student to series and shunt active power filtering techniques for harmonics for power factor improvement
CO5	To design and simulation of variable structure adaptive model 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H		H	M	--

	CO2	H	H	H		L	M	--
	CO3	H	H	H		L	M	--
	CO4	H	M	H	M	H	M	--
	CO5	H	M	H	M	H	M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS043 POWER QUALITY	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS043** POWER QUALITY	H	H	L			M	-

P18PEPS044	**ARTIFICIAL INTELLIGENCE TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – **Neural networks**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES .

Students will be able to understand fuzzy logic, neural network and applications

Module 1: **8 hours**

Biological foundations to intelligent Systems-Artificial Neural Networks, Single layer and Multilayer Feed Forward NN- LMS and Back Propagation Algorithm- Feedback networks and Radial Basis Function Networks

Module 2: **8 Hours**

Fuzzy Logic-Knowledge Representation and Inference Mechanism-Defuzzification Methods.

Module 3: **8 Hours**

Fuzzy Neural Networks-some algorithms to learn the parameters of the network like GA.

Module 4: **8 Hours**

System Identification using Fuzzy and Neural Network.

Module 5: **8 Hours**

Genetic algorithm-Reproduction cross over, mutation-Introduction to evolutionary program.

Module 6: **5 Hours**

Applications of above mentioned techniques to practical problems

TEXTBOOKS /REFERENCES

1. J M Zurada , "An Introduction to ANN", JaicoPublishing House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com

COURSE OUTCOMES (COs)	
CO1	To Study about the artificial neural networks and its Functions.
CO2	To study the methods of fuzzy logic system.
CO3	To study about the neuro fuzzy systems.
CO4	To study the System Identification in fuzzy and Neural Networks.
CO5	To Understand the concept of genetic algorithms.
CO6	To Study the practical applications of all soft computing 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	M			H	H	H	M
	CO2		L		H		H	M
	CO3	H			H	H	H	M
	CO4	H			H		H	M
	CO5		L		H		H	M
	CO6	H	L		H	H	H	H
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS044 ARTIFICIAL INTELLIGENCE TECHNIQUES	M	M	M

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO	PO3	PO4	PO5	PSO1	PSO2

			2					
2	**P18PEPS44** ARTIFICIAL INTELLIGENCE TECHNIQUES	H	L		H	H	H	H

PROFESSIONAL ELECTIVE- V

OBJECTIVES

Students will be able to:

- Learn the reasons for occurrence of transients in a power system

P18PEPS051	**POWER SYSTEM TRANSIENTS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – **power system**				
	Course Designed by – Department of Electrical & Electronics Engineering				

- Understand the change in parameters like voltage , frequency and lightning during transients

SYLLABUS

Module 1: **8 hours**

Fundamental circuit analysis of electrical transients,Laplace Transform method of solving simple Switching transients, damping circuits -Abnormal switching transients, Three-phasecircuits and transients,Computation of power system transients

Module 2: **8 hours**

Principle of digital computation – Matrix method of solution,Modal analysis- Z transform-Computation using EMTP,Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

Module 3: **8 hours**

Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance,Switching: Short line or kilometric fault, Energizing transients - closing andre-closing of lines,line dropping, load rejection – over voltages induced by faults

Module 4: **8 hours**

Switching HVDC line Travelling waves on transmission line, Circuits with distributed Parameters ,Wave Equation, Reflection, Refraction, Behavior of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave

Module 5: **6 hours**

Insulation co-ordination: Principle of insulation, co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), Co-ordination between insulation and protection level, Statistical approach

Module 6: **6hours** Protective devices, Protection of system against over voltages,lightning arresters, substation earthling.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients In Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic Transients In Power System", John Wiley And Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A Statistical Approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu And V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook Of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution And Use," Wiley, 2012.

COURSE OUTCOMES (COs) Students will be able to:	
CO1	Knowledge of analyses of switching transients
CO2	Understand the causes and effects of switching and lightning surges.
CO3	Understand the interaction between lightning and power system
CO4	Understand travelling wave propagation on transmission lines.
CO5	Coordinating the insulation of various equipment in power system
CO6	Ability to design various protective devices in power system for protecting equipment and personnel

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	PSO1	PSO2
2	CO1	H	H			M	H	
	CO2			H				H
	CO3							H
	CO4						H	
	CO5						H	
	CO6	H	H	H				H
3	Category	Professional Elective Course(PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

COURSE	PEO1	PEO2	PEO3
	H	H	H

P18PEPS051 POWER SYSTEM TRANSIENTS			

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COURSE	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	**P18PEPS051** POWER SYSTEM TRANSIENTS	H	H	H			H	H

P18PEPS052	**FACTS AND CUSTOM POWER DEVICES**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – **Power System**				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

1. Students will be able to learn the active and reactive power flow control in power system
2. To understand the need for static compensators. To develop the different control strategies used for compensation.

SYLLABUS

Module 1: **9 hours**

Reactive power flow control in Power Systems- Control of dynamic power unbalances in Power System - Power flow control- Constraints of maximum transmission line loading- Benefits of FACTS Transmission line compensation- Uncompensated line -Shunt compensation, Series compensation Phase angle control- Reactive power compensation Shunt and Series compensation. Principles- Reactive compensation at transmission and distribution level.

Module 2: **9 hours**

Static versus passive VAR compensator- Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM –Compensator control- Comparison between SVC and STATCOM

Module 3: **9 hours**

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulator- TCVR and TCPAR Operationand Control Applications, Static series compensation- GCSC, TSSC, TCSC and Static synchronous series compensators andtheir Control

Module 4: **9 hours**

SSR and its damping Unified Power Flow Controller Circuit Arrangement, Operation and control of UPFC- Basic Principle of P and Q control- Independent real and reactivepower flow control- Applications

Module 5: **9 hours**

Introduction to interline power flow controller Modeling and analysis of FACTS Controllers- Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, loads that create harmonics- modeling, harmonic propagation, series and parallel resonancesmitigation of harmonics- passive filters, active filtering – shunt , series and hybrid and their control. Voltage swells

, sags, flicker, unbalance and mitigation of theseproblems by power line conditioners IEEE standards on power quality.

TEXT/REFERENCES:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New AgeInternationalPublishers, 2007.
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", SpringerVerlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar, S.Ashok , "FACTS Controllers & Applications", E-book edition, NalandaDigital Library, NIT Calicut, 2003.
5. G. T.Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

COURSE OUTCOMES (COs)	
CO1	Acquire knowledge about the fundamental principles of Passive and Active ReactivePower Compensation Schemes .
CO2	Learn various Static VAR Compensation Schemes like Thyristor/GTOControlled Reactive Power Systems; PWM Inverter based Reactive Power Systems and theircontrols.
CO3	To develop analytical modeling skills needed for modeling and analysis of Static series compensation
CO4	To learn about unified power flow controllers and their applications
CO5	To learn about modeling of Facts 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H		H			M	--
	CO2	H		H			M	--
	CO3	H		H			M	--
	CO4	H		H			M	--
	CO5	H		H	H		M	--
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS052 FACTS AND CUSTOM POWER DEVICES	H	L	--

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2

2	**P18PEPS052** FACTS AND CUSTOM POWER DEVICES	H	H	L			M	-

P18PEPS053	**INDUSTRIAL LOAD MODELING AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Control System & Power System				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To gain fundamental knowledge of Industrial Load Modeling and Control.

SYLLABUS

Module 1: **8 hours**

Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives.Methodologies-Barriers.ClassificationofIndustrialLoads.Continuous and Batch processes -Load Modeling

Module 2: **8 hours**

Electricity pricing – Dynamic and spot pricing –Models.Direct load control- Interruptible load control.Bottom up approach- scheduling- Formulation of loadModels.Optimization and control algorithms - Case studies

Module 3: **8 hours**

Reactive power management in industriescontrols-power quality impactsapplication of filters Energy saving in industries.

Module 4: **8 hours**

Cooling and heating loads.loadprofilingModeling- Cool storageTypes-Control strategiesoptimaloperation.Problem formulation- Case studies

Module 5: **6 hours**

Captive power units-operating and control strategiesPower Pooling- Operation models-Energy bankingIndustrial Cogeneration

Module 6: **6 hours**

Selection of Schemes .Optimal Operating Strategies.Peak load savingConstraints. Problem formulation- Case study.Integrated Load management for Industries.

TEXT BOOKS

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989

2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28

REFERENCES:

1.Y. Manichaikul and F.C. Schweppes ," Physically based Industrial load", IEEE Trans. on PAS, April 1981

2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Intescience Publication, USA, 1989.

3.I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
4.IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA.

COURSE OUTCOMES (COs)	
CO1	To understand the energy demand scenario.
CO2	To understand the modeling of load and pricing analozes.
CO3	To Understand Analyze systems in complex frequency domain and Study Reactive power management in Industries
CO4	To understand the Knowledge about cooling and heating loads and optimization.
CO5	To Learn about captive power units and co-generation.
CO6	To study about the integrated load management and 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	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
2	CO1	H	H	H	L		H	L
	CO2	H	M		M		H	L
	CO3	H	H	H	L		H	L
	CO4	M	M		M		H	L
	CO5	H	M		M		H	L
	CO6	H	H	H	L		H	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS053 INDUSTRIALLOAD MODELING AND CONTROL	H	M	L

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2

2	**P18PEPS053** INDUSTRIAL LOAD MODELING AND CONTROL	H	H	H	L		H	L

P18PEPS054	**DYNAMICS OF LINEAR SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Control System				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

Students will be able to: To understand the dynamics of linear system and its functions

SYLLABUS

Module 1: **8 hours**

State variable representations of systems. Transfer function and transfer function matrix. Solutions of state equations

Module 2: **8 hours**

Observability and controllability. Minimal realization of MIMO systems. Analysis of linear time varying systems. The concepts of stability

Module 3: **8 hours**

Lyapunov stability analysis. Lyapunov function and its properties. Controllability by state variable feedback

Module 4: **7hours**

Ackerman's Formula - stabilization by output feedback. Asymptotic observers for state measurement. Observer design

Module 5: **6 hours**

State space representation of discrete systems. Solution of state equations, controllability and observability. Stability analysis using Lyapunov method

Module 6: **8 hours**

State feedback of linear discrete time systems. Design of observers - MATLAB Exercises

TEXT BOOKS:

1.M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997

2. C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston ,1984

3. R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

REFERENCES :

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.

2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.

3.K. Ogata, "Modern Control Engineering, (second edition)" , Prentice Hall Inc., Englewood Cliffs, N.J., 1990

COURSE OUTCOMES (COs)	
CO1	To learn State variable representations of systems.and transfer function and transfer function matrix.
CO2	To understand the Observability and controllability and the concepts of stability
CO3	To understand Lyapunov function and its properties and Controllability by state variable feedback
CO4	To understand stabilization by output feedback andsymptotic observers for state measurement.
CO5	To understand State space representation of discrete systems and Stability analysis using Lyapunov method
CO6	To understand the State feedback of linear discrete time systems and Design of observers

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	PSO1	PSO2
2	CO1	H	H	H		H	H	L
	CO2	H	L	H			H	L
	CO3	H	M	H	H	M	H	L
	CO4	H	M	M			H	L
	CO5	H	L	M		M	H	L
	CO6	H	M	M	H		H	L
3	Category	Professional Elective Course (PEC)						
4	Approval	47th Meeting of Academic Council						

Mapping of Course with Program Educational Objectives (PEOs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low			
COURSE	PEO1	PEO2	PEO3
P18PEPS054 DYNAMICS OF LINEAR SYSTEMS	H	H	L

Mapping of Course with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
		PO 1	PO2	PO3	PO 4	PO5	PSO1	PSO2
	P18PEPS054 DYNAMICS OF LINEAR SYSTEMS	H	H	H		H	H	L

OPEN ELECTIVE

		L	T	P	C
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – **NIL**				
	Course Designed by – Department of Management/AICTE Course Approved in 47th Meeting of Academic Council				

OBJECTIVES

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module 1 **9 Hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 **9 Hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 **9 Hours**

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module 4 **9 Hours**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module 5 **5 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module 6 **4 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

REFERENCES:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEME002	INDUSTRIAL SAFETY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering/AICTE Course Approved in 47th Meeting of Academic Council				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module 1:Industrial safety **9 Hours**

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.

Module 2:Fundamentals of maintenance engineering **9 Hours**

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.

Module 3:Wear and Corrosion and their prevention **9 Hours**

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

Module 4:Fault tracing **9 Hours**

Fault tracing-concept and importance, decision tree concept, 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.

Module 5:Periodic and preventive maintenance **9 Hours**

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

Total No. of Periods: 45

REFERENCES:

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.

P18OEMA003	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mathematics/AICTE Course Approved in 47th Meeting of Academic Council				

OBJECTIVES

- To apply the dynamic programming to solve problems of discreet and continuous variables.
- To apply the concept of non-linear programming.
- An ability to carry out the sensitivity analysis.
- An ability to model the real world problem and simulate it.

SYLLABUS

Module 1: **9 Hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module 2: **9 Hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module 3: **9 Hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem -max flow problem - CPM/PERT

Module 4 : **9 Hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5: **9 Hours**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, DynamicProgramming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total No. of Periods: 45

REFERENCES:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Management/AICTE Course Approved in 47th Meeting of Academic Council				

SYLLABUS:

Module 1: **9 hours**

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module 2: **10 hours**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module 3: **10 hours**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 4: **6 hours**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

REFERENCES:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering/AICTE Course Approved in 47th Meeting of Academic Council				

SYLLABUS

Module 1:Introduction **9 Hours**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2:Reinforcements **9 Hours**

Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module 3:Manufacturing of Metal Matrix Composites **9 Hours**

Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module 4:Manufacturing of Polymer Matrix Composites **9 Hours**

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module 5:Strength **9 Hours**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.**Total No. of Periods: 45**

TEXT BOOKS:

1 Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2 Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.

Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen

P18OEEE006	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering Course Approved in 47th Meeting of Academic Council				

SYLLABUS

Module 1: **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Module 2: **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3: **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4: **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5: **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit I& Audit II

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS:

Module 1: **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module 2: **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction

Module 3: **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

Module 4: **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature.

Module 5: **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Module 6: **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook

Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	AUDIT: DISASTER MANAGEMENT	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

Module 1: Introduction **4 Hours**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Module 2:Repercussions of Disasters and Hazards **4 Hours**

Economic Damage, Loss ofHuman and Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

Module 3:Disaster Prone Areas in India **4 Hours**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Module 4: Disaster Preparedness and Management **4 Hours**

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module 5:Risk Assessment **4 Hours**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Module 6: Disaster Mitigation **4 Hours**

Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

Module 1: **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module 2: **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

Module 3: **8 Hours**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

REFERENCES

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

COURSE OUTPUT

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS:

Module 1: **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism .Moral and non- moral valuation. Standards and principles. Value judgements

Module 2: **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module 3: **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Module 4: **6 Hours**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality ,Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind ,Self-control. Honesty, Studying effectively.

REFERENCES

- Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

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.

SYLLABUS:

Module 1: History of Making of the Indian Constitution **4 Hours**

History Drafting Committee, (Composition& Working)

Module 2: Philosophy of the Indian Constitution **4 Hours**

Preamble, Salient Features

Module 3: Contours of Constitutional Rights & Duties **4 Hours**

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.

Module 4: Organs of Governance **4 Hours**

Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Module 5: Local Administration **4 Hours**

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

Module 6: Election Commission **4 Hours**

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.

REFERECES

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 OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

Module 1: Introduction and Methodology 4 Hours

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions,Overview of methodology and Searching.

Module 2: Thematic overview 2 Hours

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

Module 3: Evidence on the effectiveness of pedagogical 4 Hours

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

Module 4: Professional development 4

HoursAlignment with classroom practices and follow-up support Peer support Support from the head teacher and the community.Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module 5:Research gaps and future directions 2 Hours

Research design, Contexts, Pedagogy Teacher education**,**Curriculum and asessment,Dissemination and research impact.

REFERENCES

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

- ✓ Agrawal M (2004) curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

P18ACYO007	**AUDIT: STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS:

Module 1: **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

Module 2

Yam and Niyam.

Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module 3: **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayama

REFERENCES:

'Yogic Asanas for Group Tarining-Part-I" Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

COURSE OUTCOMES:

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

P18ACBA008	AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS:

Module 1: **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module 2:

Approach to day to day work and duties. **8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module 3: **8 Hours**

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. ShrimadBhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

REFERENCES:

- "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
- Department), Kolkata
- Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES:

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity

Study of Neetishatakam will help in developing versatile personality of students.

CURRICULUM AND SYLLABUS
(R2018)

(Applicable to the batches admitted from July 2018)

M.Tech – Automobile Engineering
(FULL TIME)
I – IV SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCAU101	PC	Automotive Engines and Subsystems	3	3	0	0	3
2	P18PCAU102	PC	Automotive Chassis	3	3	0	0	3
3		PE	Professional Elective - 1	3	3	0	0	3
4		PE	Professional Elective - 2	3	3	0	0	3
5	P18PRAU103	PR	Research Methodology and IPR	2	2	0	0	2
6		AC	Audit I	2	2	0	0	0
PRACTICAL								
8	P18LCAU1L1	LC	Automotive Engines Lab	4	0	0	4	2
9	P18LCAU1L2	LC	Automotive Chassis Lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	P18PCAU201	PC	Vehicle Design	3	3	0	0	3
2	P18PCAU202	PC	Automotive Transmission	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
6		AC	Audit II	2	2	0	0	0
PRACTICAL								
7	P18LCPD2L1	LC	Automotive Electrical and Electronics Laboratory	4	0	0	4	2

8	P18LCAU2L2	LC	Computer Aided Vehicle Design Lab	4	0	0	4	2
9	P18PRAU2P1	PR	Mini Project with Seminar	4	0	0	4	2
			Total	26	14	0	12	18

SEMESTER III								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRAU3P2	PR	Dissertation Phase – I	20	0	0	20	10
Total				26	6	0	20	16

SEMESTER IV								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
1	P18PRAU4P3	PR	Dissertation- Phase-II	32	0	0	32	16
Total				32	0	0	32	16

TOTAL CREDITS FOR THE PROGRAM = 68

LIST OF ELECTIVES

PROGRAM ELECTIVE - I

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18 PEAU011	Advanced Mathematics for Automobile Engineers	3	3	0	0	3
2	P18 PEAU012	Automotive Electrical and Electronics	3	3	0	0	3
3	P18 PEAU013	Advanced Theory of IC Engines	3	3	0	0	3
4	P18 PEAU014	Advanced Materials for Automotive Engineers	3	3	0	0	3

PROGRAM ELECTIVE - II

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18PEAU021	Automotive Safety and Ergonomics	3	3	0	0	3
2	P18 PEAU022	Vehicle Maintenance	3	3	0	0	3
3	P18 PEAU023	Computer Simulation of IC Engine Processes	3	3	0	0	3
4	P18 PEAU024	Computer Aided Design (CAD)	3	3	0	0	3

PROGRAM ELECTIVE - III

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18 PEAU031	Vehicle Dynamics	3	3	0	0	3
2	P18 PEAU032	Automotive Pollution and Control	3	3	0	0	3
3	P18 PEAU033	Automotive Air-conditioning systems	3	3	0	0	3
4	P18 PEAU034	Alternative Fuels and Propulsion Systems	3	3	0	0	3

PROGRAM ELECTIVE - IV

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18 PEAU041	Engine and Vehicle Management Systems	3	3	0	0	3
2	P18 PEAU042	Noise vibration and Harshness	3	3	0	0	3
3	P18 PEAU043	Transport Management and Motor Industry	3	3	0	0	3
4	P18 PEAU044	Manufacturing of Automotive Components	3	3	0	0	3

PROGRAM ELECTIVE - V

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18 PEAU 051	Vehicle Body Engineering	3	3	0	0	3
2	P18 PEAU 052	Tyre Technology	3	3	0	0	3
3	P18 PEAU 053	Automotive Aerodynamics	3	3	0	0	3
4	P18 PEAU 054	Electric and Hybrid Vehicles	3	3	0	0	3

OPEN ELECTIVE

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

AUDIT COURSES I &II

SL.NO.	CODE NO.	COURSE TITLE	Contact Periods	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

P18PCAU101	AUTOMOTIVE ENGINES AND SUBSYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Thermal Engineering, Internal Combustion Engines				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

COURSE OUTCOMES (COs)

CO1	To Know the basics on operating cycles of SI and CI engines
CO2	To Study about fuel supply and fuel injection systems in SI and CI engines
CO3	To Learn about various types of cooling and lubrication system in SI and CI engines
CO4	To learn about the stages involved in combustion with utilization of optimized design on combustion chamber
CO5	To Learn about new technological innovations on engine and its management systems with recent development 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I ENGINE BASIC THEORY 9

Engine types - operating cycles of SI and CI Engines - Engine design and operating parameters - Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine - performance and emissions from SI and CI engines- Standards for Bharath stages and other Standards.

UNIT II FUEL SUPPLY, IGNITION SYSTEM 9

Theory of carburetion and carburetors — Design aspects — Petrol Injection and diesel fuel injection - pumps and injectors, gasoline direct injection system - conventional and electronic ignition systems for SI engine.

UNIT III COOLING AND LUBRICATING SYSTEM 9 Air cooling and water cooling – thermosympon cooling, forced cooling systems. Fins and radiator - design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petroil lubrication system, forced feed lubrication system.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 9

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion — combustion in SI and CI engines. - Cylinder pressure data and heat release analysis. Optimized design of combustion chambers.

UNIT V NEW ENGINE TECHNOLOGY 9

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogenous charge compression ignition in diesel engines – variable valve timing - electronic engine management.

TEXTBOOK

1. J.B.Heywood, 'Internal combustion engine Fundamentals', McGraw Hill Book Co, 1989.
2. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.

REFERENCES:

1. Edward F.Obert, 'Internal combustion engines and air pollution' Harber and Row Publishers, 1973.
2. M.Khovakh, 'Motor Vehicle Engines', Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, 'Automotive Emission control', McGraw Hill Book Co, 1995.
4. G.S.Springer and A.J.Patterson, 'Engine emissions and pollutant formation', plenum press, Newyork, 1985.

P18PCAU102	AUTOMOTIVE CHASSIS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Automobile Engineering, Vehicle Body Engineering				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

COURSE OUTCOMES (COs)

CO1	To Know the basics on drive location and frame construction on vehicles
CO2	To Study about Steering geometry, Steering gear box with types and steering conditions

CO3	To Learn about various types of Rear axle , final drive and its mechanism
CO4	To learn about the constructional details and types of braking system and to analy its braking performance with tests.
CO5	To study on suspension system with its type along with the construction of tyres a 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I INTRODUCTION 10

Layout with reference to power plant, steering location and drive, frames, constructional details, materials, testing of frames, integral body construction.

UNIT II FRONT AXLE STEERING SYSTEM 12

Front axle type, rigid axle and split axle, Constructional Details, Materials, Front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out. Condition for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkages layout for conventional and independent suspensions. Turning radius, instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering

UNIT III DRIVE LINE STUDY 12

Effect of driving thrust and torque –reaction .Hotchkiss drives. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drive- different types. Two speed rear axle. Rear axle construction-full floating, three quarter floating and semi-floating arrangements. Differential-conventional type, Non-slip type, Differential locks and differential housing.

UNIT IV BRAKING SYSTEM 12

Type of brakes, Principles of shoe brakes. Constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake, drum brake theory,

constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Exhaust brakes, power and power assisted brakes. Testing of brakes.

UNIT V SUSPENSION SYSTEMS14

Types of suspension, Factors influencing ride comfort, Types of suspension springs-independent suspension- front and rear. Rubber, pneumatic, hydro- elastic suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, tubeless tyres and aspect ratio of tube tyres.

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.
2. P.M.Heldt, "Automotive Chassis", Chilton Co., New York, 1982.
3. W.Steed, "Mechanics of Road Vehicles", Illiffe Books Ltd., London. 1992.

REFERENCES:

1. Harban Singh Rayat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.
2. G.J.Giles, "Steering Suspension and Tyres", Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi, 2005.
5. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.

P18PRAU103	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	2	0	0	2
	Prerequisite:				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

- Understanding that when IPR would take such important place in growth of individuals &

Nation, it is needless to emphasis the need of information about Intellectual Property Right

to be promoted among students in general & engineering in particular.

- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

COURSE OUTCOMES (COs)

CO1	To understand research problem formulation.
CO2	To analyze research related information
CO3	To understand need of information about Intellectual Property Right to be promoted among students in general & engineering
CO4	To understand the role on growth for individuals and nation
CO5	To know and understand the patent rights

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

1	COs/POs	a	b	c	d	e

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Teaching Scheme
Lectures: 1hrs/week

Course Outcomes:

At the end of this course, students will be able to
Follow research ethics

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals &
  Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

P18LCAU1L1	AUTOMOTIVE ENGINES LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Automotive Engines and Emissions, Alternate Fuels, IC Engines				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles with performance study of SI and CI engines.

COURSE OUTCOMES (COs)

CO1	To Know and to study the performance aspects of SI and CI engines
CO2	To Study and to determine the Pressure crank angle
CO3	To learn about CMC & PMC Characteristics with its type in detail
CO4	To learn about Heat Balance Test on IC engines
CO5	To study on Assembling and Dismantling of various SI and CI 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS

1. Study of the Following Engines and Its Components by Dismantling, Comparing With Recent Engine Components and Assembling Various Parts:
   a) Tata Engine
   b) Leyland Engine
   c) Anyone type of CRDI engine

d) Anyone type of EFI engine
e) Two Stroke Engines

2. Engine Overhaul Procedure
3. Study, Dismantling and Assembling of a Carburetor
4. Study, Dismantling and Assembly ofa Mechanical Fuel Pump
5. Measurement of Critical Dimensions of
   a) Piston
   b) Connecting Rod
   c) Piston Rings
   d) Crankshaft
   e) Valves

6. Find the Cubic capacity and Compression ratio of a vehicle.
7. Other Engine Subsystems/Components.
   a) Fuel filter
   b) Injector
   c) Turbocharger
   d) Radiator
   e) Thermostat
   f) Water Pump
   g) Oil Pump
   h) Catalytic convertor
   i) Muffler

P18LCAU1L2	**AUTOMOTIVE CHASSIS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	4	2
	Prerequisite – Automotive Technology, Automotive Braking and Suspension Systems, Vehicle Body Engineering and Chassis Management systems				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE

Study of the Following Engines and Its Components by Dismantling, Comparing With Recent Engine Components and Assembling Various Parts

Course Outcomes

CO1 – Dismantling procedure of Clutch, Gear Box, Brake system

CO2 – Dismantling procedure of Differential Unit

CO3 – Study and Propeller Shaft Unit

CO4 – Assembling procedure of Clutch, Gear Box, Brake system, Differential 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
2	CO1	H	H	M		H	M	M	M	H	H	H	H
	CO2									M			
	CO3		H	H	M	H	H	H		H		M	H
	CO4	H					L		M		M		
	CO5			H		H		M		M		M	M
	CO6	L	M	M		M	L		L	M	M	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

LIST OF EXPERIMENTS

1. Study, Dismantling & Assembling of Clutch Assembly
2. Study, Dismantling & Assembling of Gear Box Assembly
3. Study, Dismantling & Assembling of Differential Unit
4. Study of Propeller Shaft Unit
5. Study, Dismantling & Assembling of Steering Gear Boxes
   a) Rack and Pinion (Power and Manual) types
   b) Recirculating Ball type
6. Measurement Of Critical Dimensions of
   a) Ladder Frame Chassis
   b) Monocoque Body
7. Calculation Of Gear Ratios
   a) Differential Unit
   b) Gear Box
8. Study of Pneumatic/ Hydraulic Brake system.
9. Study of Front axle assembly –critical dimensions

P18PCAU201	**VEHICLE DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Basic Mechanical Engineering, Engineering Design, Machine and Component Drawing				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge vehicle frame and suspension, front axle and steering systems, clutch, gear box, drive line and rear axle will be taught to the students.

Course Outcomes

CO1 - To learn the detailed study of vehicle frame and suspension

CO2 - To learn the detailed study of front axle and steering systems

CO3 - To learn the detailed study of gear box

CO4 – To learn the detailed study of drive line and rear axle

CO5 – To learn of detailed study of drive line and rear axle

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of 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	H	H	H	M
	CO2		M				H		L	H			M
	CO3		H		H	H		H		H		M	H
	CO4	H				M	H		H		H		
	CO5			M		H		M	M	H		M	H
	CO6	L	M	M		L	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

UNIT – I VEHICLE FRAME AND SUSPENSION 12

Study of loads - moments and stresses on frame members. Design of frame for passenger and commercial vehicle - design of leaf springs - Coil springs and torsion bar springs.

UNIT – II FRONT AXLE AND STEERING SYSTEMS 12

Analysis of loads - moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of bearings. Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering. Design of Front Axle Beam.

UNIT – III CLUTCH 12

Torque capacity of single plate, multi plate and cone clutch. Design of clutch components, Design details of roller and sprag type of clutches. .

UNIT – IV GEAR BOX 12

Gear train calculations, layout of gear box constant mesh and synchrono mesh gear box. Design of three speeds and four speed gear boxes.

UNIT – V DRIVE LINE AND REAR AXLE 12

Design of propeller shaft and types of propeller shaft. Design details of final drive gearing. Design details of full floating. Semi-floating and three quarter floating rear shafts and rear axle housings. Design aspects of final drive.

TEXT BOOKS:

1. Heldt,P.M., Automotive Chassis, Chilton Book Co., 1992.
2. Heldt,P.M., Torque Converters, Chilton Book Co., 1992.

REFERENCES:

1. Giri,N.K., Automobile Mechanics, Khanna Publishers, New Delhi, 1998.
2. W. Steeds, "*Mechanics of Road Vehicles*", lliffe Books Ltd, London, 1990.

P18PCAU202	AUTOMOTIVE TRANSMISSION	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Automobile Engineering, Machine Design, Automotive Chassis				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

COURSE OUTCOMES (COs)

CO1	To Know and to study about Clutch and Gearbox with its type in detail
CO2	To Study on various types of hydrodynamic torque transmission and its performance characteristics
CO3	To Know about Automatic Transmission and its type in detail
CO4	To learn the principle of Hydrostatic and Electric drive system elaborately
CO5	To study on applications of Automatic Transmission with its characteristics

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I CLUTCH AND GEAR BOX 15

Requirement of Transmission system. Different types of clutches: Principle, construction and operation of friction clutches. Objective of the gear box. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications. Different types of gear boxes.

UNIT II HYDRODYNAMIC DRIVES 13

Principles, performance and limitations of fluid coupling Constructional details of a typical fluid coupling. Reduction of drag torque, Principle, construction and advantages of hydrodynamic torque converters. Performance characteristics, converter couplings. Multi-stage Torque converter and poly phase torque converter.

UNIT III AUTOMATIC TRANSMISSION 11

Ford – T model gear box, Wilson gear box- Cotal electric transmission– Hydraulic control systems of automatic transmission.

UNIT IV HYDROSTATIC DRIVE AND ELECTRIC DRIVE 9

Principle of hydrostatic drive systems. Construction and working of typical drives. Advantages and limitations. Control of hydrostatic transmissions, Principle of electric drive. Early and modified Ward Leonard control systems.

UNIT V AUTOMATIC TRANSMISSION APPLICATIONS 12

Chevrolet "Turbo glide" transmission. Toyota's Automatic transmission with Electronic control system. Continuously Variable Transmission (CVT) – types – Operations.

TEXTBOOK:

1. Heldt P.M, Torque Converters, Chilton Book Co., 1992.
2. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.

REFERENCES:

1. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002.
2. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005.

P18LCPD2L3	AUTOMOTIVE ELECTRICAL & ELECTRONICS LAB	L	T	P	C
	Total Contact Hours: 45	0	0	2	2
	Prerequisite: Basic Electrical and Electronics, Automotive Electrical and Electronics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To provide hands on training on automotive electrical and electronic systems and to provide knowledge on interfacing of different sensors and actuators used in the automobile systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics
CO2	To Know about the Electrical and Electronics Systems with their Characteristics
CO3	To study and to visualize the characteristics of Load cells, thermocouple and Strain gauge
CO4	To study about the Thermometers and Transducers
CO5	To study on the basic programming of Microprocessor and Microcontroller with interfacir 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

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS:

Study of electrical systems such as

1. Battery
2. Lighting system
3. Electric horn system
4. Windscreen wiper system
5. Starting motor and drive system
6. Charging system
7. Ignition system

Experiments on

1. Basic Digital circuits
2. Timer
3. Seven segment displays
4. Characteristics of load cells
5. Characteristics of thermocouples
6. Characteristics of resistance thermometers
7. Characteristics of piezoelectric pressure transducers
8. Characteristics of LVDT
9. Characteristics of Strain gauges
10. Programming of microprocessor.
11. Programming of microcontroller.
12. Interfacing of microprocessors,
13. Interfacing of micro controllers.
14. Mini project

P18LCAU2L4	COMPUTER AIDED VEHICLE DESIGN LAB	L	T	P	C
	Total Contact Hours: 45	0	0	2	2
	Prerequisite: Vehicle Design, Design of Machine Components				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the designing and evaluating the automobile engine components such as Piston, Connecting rod, Crankshaft, Journal bearings, Camshaft and Automobile chassis components such as Vehicle Chassis, Leaf Spring and Rear axle systems with calculation and model analysis.

COURSE OUTCOMES (COs)

CO1	To Know and to study the Design and Analysis part of Automobile Components
CO2	To Design and to analyze the Engine components with design calculation and Model Analysis
CO3	To Design and to analyze the Chassis components with design calculation and Model Analysis
CO4	To Design and Analyze the Front and Rear axle systems
CO5	To Design and Analyze the various types of gearboxes

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Design calculation, model and analyze the following automobile components

1. Piston, piston pin and piston rings
2. Connecting rod.
3. Automobile valves
4. Crank shaft
5. Cam shaft
6. Vehicle Chassis

7. Leaf spring, coil spring and torsion bar.
8. Front axle system of a typical 4 Wheeled vehicle
9. Rear axle system of a typical 4 wheeled vehicle
10. Three speed and four speed gear boxes of a heavy vehicle

REFERENCES:

1. Dean Averns, "Automobile Chassis Design ", Illiffe Books Ltd, 1992.
2. Richard Stone, "Introduction to Internal Combustion Engines", McMillan. London, 1985.
3. Bosch, "Automotive Handbook" 6th edition, SAE, 2004.
4. Heldt.P.M. "Automotive Chassis ", Chilton Co., New York, 1992.
5. Steeds'. "Mechanics of Road vehicles ", Illiffe Books Ltd., London, 1990.
6. Giles.J.G. Steering, "Suspension and tyres ", Illiffe Books Ltd., London, 1988.
7. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.
8. Heldt.P.M. "Torque converter ", Chilton Book Co., New York, 1982.
9. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005
10. ACAD, CATIA and ANSYS software guide / manual

P18PRAU2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

- The purpose of technical seminar is to train the students in preparing and presenting Technical topics.
- The students are expected to give a presentation on their topics of interest which will be Assessed by a Faculty in charge, for this purpose during the current semester as per the Academic regulations.
- The student shall be capable of identify design, fabricate mini projects of power electronic Components

P18PRAU3P1	**PHASE I DISSERTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	6	6
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Automobile Engineering				
OBJECTIVES The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.					
COURSE OUTCOMES (COs)					

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowledge sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Core (PC)				
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

P18PRAU4P2	**PHASE II DISSERTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	12	12
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowlec sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

LIST OF ELECTIVES

PROGRAM ELECTIVE - I

P18PEAU011	ADVANCED MATHEMATICS FOR AUTOMOBILE ENGINEERS	L	T	P	C
	Total Contact Hours: 60	3	2	0	4
	Prerequisite: Engineering Mathematics-I, II & III, Numerical methods				
	Course Designed by :Department of Mathematics				

OBJECTIVES

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

COURSE OUTCOMES (COs)

CO1	To learn and Compute eigen values and eigen vectors by different methods.
CO2	To Solve different non-linear ordinary and Partial differential equations
CO3	To Solve Problems of variation applicable in Automobile engineering.
CO4	To Find numerical solution for advanced problems in interpolation and integration
CO5	To Solve LPP by different algorithms.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	47th Meeting of Academic Council-Aug, 2018

UNIT I MATRIX THEORY **12**

Eigen values using QR transformations – generalized eigen vectors – canonical forms – singular value decomposition and applications –pseudo inverse – least square approximations.

UNIT II DIFFERENTIAL EQUATIONS – NONLINEAR ODE & PDE **12**

Introduction – Equations with separable variables – Equations reducible to linear form – Bernoulli's equation – Riccati's equation – Special forms of Riccati's equation – Laplace transform methods for one dimensional wave equation – Displacement in a long string – Longitudinal vibration of an elastic bar.

UNIT III CALCULUS OF VARIATION **12**

Introduction – Euler's equation – several dependent variables Lagrange's equations of Dynamics – Integrals involving derivatives higher than the first – Problems with constraints – Direct methods and Eigen value problems.

UNIT IV INTERPOLATION AND INTEGRATION **12**

Hermite's Interpolation – Cubic Spline Interpolation – Gaussian Quadrature – Cubature.

UNIT V LINEAR PROGRAMMING PROBLEM **12**

Simplex algorithm – Two-phase and Big-M Techniques – Duality theory – Dual simplex method – Integer programming - Gomory's cutting plane method.

REFERENCES

1. Stephenson, G, Radmore, P.M., "Advanced Mathematical Methods for Engineering and Science Students", Cambridge University Press 1999.
2. Richard Bronson, "Matrix Operations", Schaum's Outline Series, 2nd Edn. McGraw Hill, New York, 1989.
3. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley, 8th Edition, 2004.
4. Sastry.S.S, "Introductory Methods of Numerical Analysis", 5th Edn. PHI, New Delhi.2008
5. Gupta, A.S. "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
6. Sankara Rao.K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd.,New Delhi, 1997.
7. Hamdy A.Taha. "Operations Research-An Introduction". 8th Edn. PHI, New Delhi. 2007.

P18 PEAU012	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Electrical and Electronics, Automotive Electrical systems				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

COURSE OUTCOMES (COs)

CO1	To Know and to study the basics of Automobile Charging and Starting systems with its characteristics and mechanism
CO2	To Study the basic elements of Charging and Lighting system with its accessories
CO3	To learn about Mechanism of Electronic Ignition and Injection systems
CO4	To study about the various sensors in a vehicle
CO5	To study aboutMicroprocessor and Microcontroller applications in Automobiles

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I BATTERIES AND STARTING SYSTEM 9

Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

UNIT II CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES 9

D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS 9

Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

UNIT IV SENSORS IN AUTOMOBILES 9

Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, altitude sensor, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

UNIT V MICROPROCESSOR IN AUTOMOBILES 9

Microprocessor And Microcomputer controlled devices in automobiles such as instrument cluster, Voice warning system, Travel information system, Keyless entry system, Automatic Transmission. Environmental requirements (vibration, Temperature and EMI).

TEXTBOOK:

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chamman & Hall, London, 1992.
2. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, 1998
3. Young. A.P. & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.

REFERENCES:

1. Vinal. G.W., Storage Batteries, John Wiley & Sons inc., New York, 1985.
2. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980.
3. Spreadbury.F.G. Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.
4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
5. Kohli P L., "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004

P18 PEAU013	ADVANCED THEORY OF IC ENGINES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC engines, Automotive Pollution and Control, Environment and Ecosystems				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in introduction, combustion of fuels, combustion modelling, non-conventional ic engines, combustion analysis in ic engines will be taught to the students.

Course Outcomes

CO01 - To learn the detailed study of introduction

CO02 - To learn the detailed study of combustion of fuels													
CO03 - To learn the detailed study of combustion modelling													
CO04 – To learn the detailed study of non-conventional IC engines													
CO05 - To learn the detailed study of combustion analysis in IC 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
2	CO1	H	M	H		H	M	H	H	H	H	H	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		H		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	H		L	H		H	L	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 (H)
									√					
4	Approval	47th Meeting of Academic Council-Aug, 2018												

UNIT – I INTRODUCTION 7

Fuel air cycle and Actual cycle analysis, Properties of IC engine fuels, Refining process, chemical composition and molecular structure of fuels, octane number, cetane number. Knock rating of SI engine fuels.

UNIT – II COMBUSTION OF FUELS 12

Combustion Stoichiometry of petrol, diesel, alcohol and hydrogen fuels – Chemical energy and heating values – Chemical equilibrium and maximum temperature – SI engine combustion – Flame velocity and area of flame front –performance number – CI engine combustion. Fuel spray characteristics – droplet size, penetration and atomization.

UNIT – III COMBUSTION MODELLING 10

Basic concepts of engine simulation – Governing equations, thermodynamic models – SI engine and CI engine models.

UNIT – IV NON-CONVENTIONAL IC ENGINES 8

Adiabatic and L.H.R. engines – Variable compression ratio engine – Wankel rotary combustion engine – Free piston engine - MAN combustion chamber and multi fuel engines – Stratified charge and lean burn engines – Locomotive and marine engines.

UNIT – V COMBUSTION ANALYSIS IN IC ENGINES 8

Photographic studies of combustion processes – P-θ diagrams in SI and CI engines, Rate of heat release – hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines

TEXTBOOK

1. Ganesan,V., Internal combustion engines, Tata McGraw Hill Publishing Co., 1994.
2. Heldt,P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 1985.

REFERENCES

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.
2. Ganesan,V., Compute Simulation of Spark Ignition engine process, Universities Press (India) Ltd., Hyderabad, 1996.
3. John,B., Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Co., New York, 1990.

P18 PEAU014	**ADVANCED MATERIALS FOR AUTOMOTIVE ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Nano Technology and its applications, Production Technology , Metallurgy and Manufacturing Process				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in material science with modes of manufacturing process involved in construction of various technologies employed in automobile Industries. Students been focused on basics related to Nano technological developments which sustainably develop their skill in selection of materials for the process of manufacturing.

COURSE OUTCOMES (COs)

CO1	To Know and to study about FRP and its properties with its application in Automotive sector
CO2	To Study about the basics of material properties like ceramics and reinforced materials
CO3	To learn about CMC & PMC Characteristics with its type in detail
CO4	To learn about the utilization of elastomers and plastics in automotive manufacturing process
CO5	To study on Foams, Adhesives, Coatings and Paints in detail

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I FIBRE REINFORCED PLASTICS (FRP) 12

Definition; Types; General properties and characteristics; Reinforcing materials – particles, fibers, whiskers; Properties of reinforcing materials; Matrix materials; Additives; Properties of FRP materials; Automotive applications

UNIT II ENGINEERING CERAMICS AND METAL MATRIX COMPOSITE 12

Reinforcement materials; Matrix; Characteristics and specialized properties like – weibull modulus, high temperature strengths, wear & frictional property improvements; Selection criteria; Advantages and limitations in use of ceramics & MMCs; Fracture mechanics; Auto applications.

UNIT III CERAMIC & POLYMER METAL COMPOSITES 12

CMC & PMC Characteristics, Various types, Advantages & Limitations, Applications. Role of Mixtures- Reinforcement – Particles – Fibres. Carbon/Carbon Composites- Advantages, Limitations- Sol-Gel techniques – Chemical Vapor Deposits. Composite for automotive applications.

UNIT IV AUTOMOTIVE ELASTOMERS AND PLASTICS POLYMERIC MATERIALS AND MANUFACTURING PROCESSES 12

Polymerization – Thermosets Vs Thermoplastics – Classes and types of polymers; Properties and limitations of plastic material species; Additives; Auto applications – exterior, interior, engine and fuel line, transmission systems, electrical and electronic components. Injection molding, Reaction injection molding (RIM), Transfer molding, Extrusion, compression molding, blow molding, scopes and limitations of various manufacturing processes, mold making, safety in handling of materials, hands on training on processes, selection criteria for auto applications, economics

UNIT V FOAMS, ADHESIVES, COATINGS AND PAINTS 12

PU & Latex foams - Formulations and manufacturing Control of various foam properties – density, modulus of elasticity, compression set, dynamic properties, etc.Adhesives - Condensation polymerization of products like – phenol formaldehyde (Phenolic resins), Amino resins, Polyester resins, Alkyl resins, Epoxy resins, Polyurethane resins, Polyamide resins; Additional polymerization products like – Vinyl resins, Vinyl alcohol resins, vinylidine resins, Styrene resins and Acrylic resins. Protective coatings and Paints - Organic paints and coatings, metal coatings, ceramic coatings, Linings, primers, varnishes, enamels, galvanizing, anodizing, blackodizing, electro plating, CVD & PVD surface coatings,Other Materials - Seals and Gaskets, Automotive glasses, Refractory materials

TEXT BOOK

1. Haslehurst.S.E., "Manufacturing Technology ", ELBS, London, 1990.
2. Krishnan K. Chawle. "Composite Material: Science and Engineering" Second Edition, Springer, 1998.
3. T.W.Clyne, P.J. Withers, "An Introduction to metal matrix composites", Cambridge University Press, 1993.
4. F.C.Campbell "Structural Composite Materials", Materials Park,ASM International,2010.

REFERENCE BOOKS

1. Derek Hull, "An Introduction to composite Materials", Cambridge University Press, 1988.
2. B.T.Astrom, "Manufacturing of polymer composites", Champman & Hall, 1997 S.C.Sharma, "Composite Materials", Narosa Publishing House, 2000.
3. Berins, ISBN 0442010699, "Design with Plastics and Plastic Engineering", Wiley & Sons Inc., 1995.
4. D. Huda, M.A. E1 Baradie and M.S.J. Hashmi, "Metal-matrix composites: Materials aspects- Part II", Journal of Materials Processing Technology, 37 (1993) 521-541.
5. ASM Metals Hand Book, Vol.21, "Composites", ASM International, 2001.
6. Kalyan Sehanobish, "Engineering Plastics and Plastic Composites in Automotive Applications", SAE International, April 2009.
7. Francis Gardiner and Eleanor Garmson "Plastics and the Environment" Smithers Rapra, 2010.
8. Mahendra D Baijal "Plastic Polymer Science and Technology", John Wiley&Sons, 1982.

PROGRAM ELECTIVE – II

P18 PEAU014	AUTOMOTIVE SAFETY AND ERGONOMICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Control of vehicles Systems, Engine and Vehicle Management Systems				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in safety and comfort systems in automotive vehicles. It also clearly describes the basic ergonomic need in developing various vehicle applications through inputing bio thermal and bio mechanical systems.

COURSE OUTCOMES (COs)

CO1	To Know and to study about Biomechanics And Bio Thermal systems
CO2	To Study about the basics of various safety aspects and comfort systems in vehicle
CO3	To learn about Vehicle Ergonomics
CO4	To learn about the utilization of human factors and applications in automotive field
CO5	To study on advance safety systems and ergonomic factors

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M

	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I INTRODUCTION 9

Definition, human technological system, multidisciplinary engineering approach, human – machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, displays, speech communications.

UNIT II BIOMECHANICS AND BIO THERMAL 9

Biostatic mechanics, statics of rigid bodies, upper extremity of hand, lower extremity and foot, bending, lifting and carrying, biodynamic mechanics, human body kinematics, kinetics, impact and collision. Bio-thermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

UNIT III VEHICLE ERGONOMICS 9

Introduction, seating dimensions, interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Illumination, heat ventilation and air conditioning, noise, motion, speed and acceleration, sound, vibration.

UNIT IV HUMAN FACTORS APPLICATIONS 9

Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments.

UNIT V SAFETY 9

Seat belt, air bag, collapsible steering, warning systems, ABS braking system, collision safety systems, global safety standards in automotive applications.

REFERENCES:

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley & Sons, New York, 2000.
3. Martin Helandar, “A Guide to Ergonomics of Manufacturing”, Taylor and Francis, 1996.
4. Mark S S, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.
5. John Fenton, “Hand Book of Automotive Power Train and Chassis Design”, SAE, 1998.

P18 PEAU022	VEHICLE MAINTENANCE	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines. Automotive chassis, Automotive Electrical systems				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.

COURSE OUTCOMES (COs)

CO1	To know about the various maintenance tools, shops, scheduling and maintaining records
CO2	To Study the general maintenance procedure carried out in power plant through repairing and overhauling
CO3	To Study the general maintenance procedure carried out in cassis through repairing and overhauling
CO4	To Study the general maintenance procedure carried out in vehicle body
CO5	To Study the general maintenance procedure carried out in electrical system and accessories of a vehicle through repairing and replacement

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS 8

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING 12

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system, - lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 12

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 6

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 7

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

TEXTBOOK:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London, 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963

REFERENCES:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. John Dolce, Fleet maintenance, McGraw Hill, Newyork, 1984
4. A,W.Judge, Maintenance of high speed diesel engines, Chamman Hall Ltd., London, 1956.
5. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork, 1995.
6. Vehicle servicing manuals.

7. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963.

P18 PEAU023	COMPUTER SIMULATION OF IC ENGINE PROCESSES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC Engines and Emissions, Automotive Engines and Combustion Characteristics,				
	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.

Course Outcomes

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

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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	H	H	H	H	M	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	H		L	M		H	L	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 (H)
						√			
4	Approval	47th Meeting of Academic Council-Aug, 2018							

UNIT – I INTRODUCTION 8

Simulation, advantages of computer simulation, step – by – step approach, reactive processes, heat reaction, measurement of URP, measurement of HRP.

UNIT – II 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.

UNIT – III 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.

UNIT – IV 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.

UNIT – V 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.

P18 PEAU024	**COMPUTER AIDED DESIGN (CAD)**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: CAD/CAM, Computer Integrated Manufacturing, Computer aided process planning and development				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge CAD procedures and acquire skills in designing and development of a product.

COURSE OUTCOMES (COs)

CO1	To know about the CAD/CAED/CAE with its concepts and engineering applications
CO2	To Study the Graphics and Geometric transformations involved in 2D and 3D design
CO3	To Understand the properties of curve design, nature and its representation
CO4	To Study the tree dimensional designing and its procedures
CO5	To Study and to analyze the3D models in FEM 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

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT-I INTRODUCTION **9**

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I

CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II COMPUTER GRAPHICS-II **9**

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations:

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation.

UNIT-III CURVES **9**

Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV 3D GRAPHICS **9**

Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid

geometry, Sweep representation, Color models Application commands for AutoCAD & ProE software

UNIT-V NUMERICAL METHODS 9

Introduction, Errors in numbers, Binary representation of numbers, Root finding- Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

REFERENCES

1.Chris McMohan and Jimmi Browne, "CAD/CAM Principles, Practice and Manufacturing Management", Pearson Education Asia,Ltd., 2000.
2. Donald Hearn and Pauline Baker M. "Computer Graphics", Prentice Hall, Inc., 1992.
3. Ibrahim Zeid "CAD/Cam Theory and Practice", McGraw Hill, International Edition, 1998.
4. Khandare S.S., "Computer Aided Design", Charotar Publishing House, India, 2001.
5. Newman, William M., & Sproull, Robert F., "Principles of Interactive Computer Graphics", 2nd Ed., McGraw Hill, 1981.
6. Harington, Stevan, "Computer Graphics: A Programming Approach", McGraw Hill, 1983.
7.Plastock, Roy A., & Kally, "Theory and Problems of Computer Graphics", McGraw Hill, 1986.
8. Rogers. D.F., "Procedural Elements for Computer Graphics", McGraw Hill, 1985.
9.Foley, J.D. & Van dam, A., "Fundamentals of Interactive Computer Graphics", Addison – Wesley, 1982.
10.Vosinet, Donald., "Computer Aided Drafting and Design: Concepts & Applications", McGraw Hill, 1986.

PROGRAM ELECTIVE - II

P18 PEAU031	VEHICLE DYNAMICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive chassis, Automotive Aerodynamics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

COURSE OUTCOMES (COs)

CO1	To Know about basics of Vibration and Mechanical vibrating systems
CO2	To Know the classifications of tyres with its properties and distribution of moments and forces acting on them

CO3	To study about thePerformance Characteristics of a Vehicle					
CO4	To study about the Handling Characteristics of a Vehicle					
CO5	To study and to learn about the dynamics of suspension system with its characteristics					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/POs	a	b	c	d	e
2	CO1	H	H	H	H	M
	CO2	H	H	L	M	H
	CO3	H	M	H	M	L
	CO4	M	H	L	H	H
	CO5	H	M	L	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I BASIC OF VIBRATION 12

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system, Modal analysis.

UNIT II TYRES 12

Tire forces and moments, rolling resistance of tires, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

UNIT III PERFORMANCE CHARACTERISTICS OF VEHICLE 12

Equation of motion and maximum tractive effort. Aerodynamics forces and moments. Power plant and transmission characteristics. Prediction of vehicle performance. Braking performance.

UNIT IV HANDLING CHARACTERISTICS OF VEHICLES 12

Steering geometry. Steady state handling characteristics. Steady state response to steering input. Transient response characteristics. Directional stability of vehicle.

UNIT V DYNAMICS OF SUSPENSION SYSTEM 12

Requirements of suspension system. Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft, Hydraulic dampers and choice of damping characteristics.

Compensated suspension systems. Human response to vibration, vehicle ride model. Load distribution. Stability on a curved track, banked road and on a slope.

TEXTBOOK:

1. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002.
2. J.Y.Wong,' Theory of ground vehicles', John Wiley and Sons Inc., Newyork, 1978
3. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005

REFERENCES:

1. Groover, "Mechanical Vibration", 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.
2. W.Steeds, 'Mechanics of road vehicle' Illiffe Books Ltd, London 1992
3. JG.Giles, 'Steering, Suspension tyres', Illife Books Lid London 1975
4. P.M.Heldt, 'Automotive chassis', Chilton Co ., Newyork, 1982
5. J. R. Ellis, 'Vehicle Dynamics', Business Books, London, 1969.

P18 PEAU032	**AUTOMOTIVE POLLUTION AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Mechanical Engineering, Automotive Engines and sub systems				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge on various pollutants causing emissions in SI ad CI engine. It also helps to know about various test procedures to be carried out in determining SI and CI engine Emission with its control techniques.

Course Outcomes

CO1 - To learn the detailed study various pollutants causing pollution

CO2 - To learn the detailed study of SI Engine Combustion And Emissions

CO3 - To learn the detailed study of CI Engine Combustion And Emissions

CO4 – To learn the detailed study of control techniques for reduction of SI and CI Engine Emission

CO5 – To learn of detailed study of various test procedure & instrumentation for emission measurement and 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
2	CO1	H	M	H		H	M	H	H	H	H	H	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	M		L	H		H	L	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

UNIT – I INTRODUCTION 6

Pollutants – sources – formation – effects – transient operational effects on pollution – Standards for Emission of pollutants.

UNIT – II S.I. ENGINE COMBUSTION AND EMISSIONS 11

Chemistry of SI engine combustion – HC and CO formation in 4-stroke and 2-stroke SI engines – NO formation in SI engines – Particulate emissions from SI engines – Effect of operating variables on emission formation.

UNIT – III CI ENGINE COMBUSTION AND EMISSIONS 10

Basics of diesel combustion – Smoke emission in diesel engines – NO emission from diesel engines – Particulate emission in diesel engines. Color and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

UNIT – IV CONTROL TECHNIQUES FOR REDUCTION OF SI AND CI ENGINE EMISSION 9

Design changes – Optimization of operating factors – Exhaust gas recirculation – Fumigation – Air injector PCV system – Exhaust treatment in SI engines – Thermal reactors – Catalytic converters – Catalysts – Use of unleaded petrol.

UNIT – V TEST PROCEDURE & INSTRUMENTATION FOR EMISSION MEASUREMENT AND EMISSION STANDARDS 9

Test procedures – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyser – Gas chromatograph – Smoke meters – Emission standards.

TEXT BOOK

1. Springer and Patterson, Engine Emission, Plenum Press, 1990.

REFERENCES

1. Ramalingam. K.K., Internal Combustion Engines, Scitech Publications, Chennai, 2003.
2. Ganesan,V., Internal Combustion Engines, Tata McGraw Hill Co., 1994.
3. Heywood,J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1995.
4. Internal Combustion Engines, M.L.Mathur/ R.Psharma.

P18 PEAU033	AUTOMOTIVE AIR-CONDITIONING SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Refrigeration and Air-conditioning, Thermodynamics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on studying the various methods of processes involved

inAutomotive Air-Conditioning Systems. The students can able to understand the concepts involved in various cycles of refrigeration and heating.						
COURSE OUTCOMES (COs)						
CO1	To know the basics of Air Conditioning system and description of its components					
CO2	To know and to understand therefrigerant and its classification with diagnosis					
CO3	To study about the air conditioner and heating system with its description					
CO4	To study about the processes involved in air routing and temperature control systems					
CO5	To study about the heater – air conditioner trouble shooting and service 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT – I AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS 10

Basic air conditioning system – Components – types of Compressor, Condenser, Expansion devices and Evaporators. Location of air conditioning components in a car – Schematic layout of a air conditioning system. Compressor components – Thermostatic expansion valve & orifice tube – Expansion valve calibration – Evaporator temperature controls for TXV & CCOT systems.

UNIT – II REFRIGERANT 9

Requirements for refrigerants – Classification of refrigerants- Refrigerant selection-Storage of refrigerants – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT – III AIR CONDITIONER – HEATING SYSTEM 10

Manually controlled air conditioner – Heater system – Ford automatically controlled air conditioner – heater systems – Chrysler automatically controlled air conditioner – Heater

system, General Motors automatically controlled air conditioner – Heater system – Flushing & Evacuating.

UNIT – IV AIR ROUTING & TEMPERATURE CONTROL 10

Objectives – Evaporator case air flow through the Dash recirculating unit – Automatic temperature control – Ducting system in Passenger car and Bus– Controlling flow – Vacuum reserve – Testing the air control and handling systems- Load calculations - Psychrometry

UNIT – V HEATER – AIR CONDITIONER TROUBLE SHOOTING & SERVICE 6

Air conditioner maintenance and service – Servicing heater system. Removing and replacing components. Trouble shooting of air conditioner – heating system – Compressor service.

TEXT BOOK:

1. William H Crouse and Donald L Anglin, Automotive Air conditioning, McGraw Hill Inc., 1990.

REFERENCES:

1. Paul Weisler, Automotive Air Conditioing, Reston Publishing Co. Inc., 1990.
2. McDonald,K.L., Automotive Air Conditioning, Theodore Audel series, 1978.
3. Goings,L.F., Automotive Air Conditioning, American Technical services, 1974.

P18 PEAU034	**ALTERNATE FUELS AND PROPULSION SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines and Emissions, Engineering Chemistry, Automotive Pollution and its control, Fuels and Combustion.				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Understand the basic concept and to involve in replenishing the world through utilization of alternative fuels to meet over the current demand on energy scenario. The students can able to know the various alternative sources of energy other than fossil fuels and their significance.

COURSE OUTCOMES (COs)

CO1	To Study the current energy scenario and its demand on fossil fuels
CO2	To Study the general properties of alcohol with its source, performance and emission characteristics
CO3	To Study the general properties of natural gas, LPG, hydrogen and biogaswith its source, performance and emission characteristics
CO4	To Study the general properties of vegetable oilswith its source, performance and emis characteristics
CO5	To Learn the basics involved inelectric and solar powered 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L

	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT – I INTRODUCTION 6

Estimation of petroleum reserve "World Energy Scenerio, Energy Survey of India" – Need for alternate fuel – Availability of alternate fuels- Other alternate energy sources

UNIT – II ALCOHOLS 9

Properties as engine fuels, alcohols and gasoline blends, Performance in SI engine. Methanol and gasoline blends - Performance combustion and emission characteristics.

UNIT – III NATURAL GAS, LPG, HYDROGEN AND BIOGAS 9

Availability of CNG, properties, modification required to use in engines – performance and emission characteristics of CNG and LPG in SI & CI engines. Performance and emission for LPG – Hydrogen – Storage and handling, performance and safety aspects.

UNIT – IV VEGETABLE OILS 10

Various vegetable oils for engines – Transesterification – Performance in engines – Performance and emission characteristics.

UNIT – V ELECTRIC AND SOLAR POWERED VEHICLES 11

Layout of an electric vehicle – advantage and limitations – Specifications – System component, Electronic control system – High energy and power density batteries – Hybrid vehicle – Solar powered vehicles. Fuel cell vehicles.

TEXTBOOKS:

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.
2. Bechtold,R.L., Alternative Fuels Guide Book, SAE, 1997.

REFERENCES:

1. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
2. Alcohols and motor fuels progress in technology, Series No.19, SAE Publication USA 1980.

P18 PEAU041	ENGINE AND VEHICLE MANAGEMENT SYSTEMS	L	T	P	C

	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive Engines and Emissions, IC engines and Alternative Fuels, Automotive Electronics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To explain the principle of engines electronic management system and different sensors used in the systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics with its description on various systems
CO2	To Know about the various functions of Sensors and Actuators present in the vehicle
CO3	To study about the SI Engine management systems with its techniques
CO4	To study about the CI Engine management systems with its techniques
CO5	To study about the Digital engine control systems with Vehicle management systems and their 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Microprocessor architecture, 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.

UNIT II SENSORS AND ACTUATORS 9

Inductive, Hall Effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, c Engine and

vehicle design data rash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors.

UNIT III SI ENGINE MANAGEMENT 9

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch Monojetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control.

UNIT IV CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

UNIT V VEHICLE MANAGEMENT SYSTEMS 9

ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE

REFERENCES:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

P18 PEAU042	**NOISE VIBRATION AND HARSHNESS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nanotechnology, Mechanics of Materials and Automotive Chassis				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Know about the Noise, Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles.

COURSE OUTCOMES (COs)

CO1	To know and to study thebasics of vibration analysis
CO2	To know and to understand thevibration control techniques
CO3	To study about the basics of noise and its control methods
CO4	To study about the NVH measurements taken care in automotive systems
CO5	To study about the automotive noise sources and their 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

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I - BASICS OF VIBRATION ANALYSIS **9**

Basic concepts, mathematical models, formulating the equations of motion linear and torsional system characteristics and response – damped and undamped single & two degree of freedom systems under harmonic force, coordinate coupling, generalized coordinates and modal analysis.

UNIT II - VIBRATION CONTROL TECHNIQUES **9**

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, Applications: isolation of the engine from vehicle structure and control of torsional oscillation amplitudes in engine crankshaft.

UNIT III - NOISE FUNDAMENTALS **9**

Fundamentals of acoustics – general sound propagation – structure borne sound & air borne sound, Plane wave propagation - wave equation, specific acoustic impedance, acoustic intensity, Spherical wave propagation – acoustic near and far fields, Reference quantities, The decibel scale, relationship among sound power, sound intensity and sound pressure level, summation of pure tones, Decibel addition, subtraction and averaging, Effects of reflecting surfaces on sound propagation, octave band analysis, Anatomy of Human Ear, Mechanism of hearing, loudness, weighting networks, equivalent sound level.

UNIT IV - NVH MEASUREMENTS **9**

Vibration and Noise Standards – Pass/Drive by noise, noise from stationary vehicles, interior noise in vehicles, NVH measurement tools and techniques, Modal parameter (natural frequency, mode shape and damping) estimation techniques, signal and system analysis.

UNIT V-AUTOMOTIVE NOISE SOURCES AND CONTROL TECHNIQUES **9**

Methods for control of engine noise, Transmission Noise, Intake and Exhaust Noise, Aerodynamic Noise, Tyre Noise, Brake noise. Noise control strategy, noise control at source – along the path – isolation, damping, balancing, resonators, absorption, barriers and enclosures.

TEXT BOOK:

1. Matthew Harrison, "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier, 2004.

REFERENCES:

1. Bell, L. H. and Bell, D. H., "Industrial Noise Control – Fundamentals and Applications", Marcel Dekker Inc, New York, 1994.
2. Xu Wang, "Vehicle Noise and Vibration Refinement", CRC Press, 2010
3. Ambekar, A. G., "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi, 2006.
4. Beranek, L. L. and Ver, I, L., "Noise and Vibration Control Engineering –Principles and Application", John Wiley & Sons, Inc, 1 992.
5. Wilson, C. E., "Noise Control – Measurement, Analysis, and Control of Sound and Vibration" Harper & Row Publishers, New York, 1989.
6. Thomson, W. T., "Theory of Vibrations with Applications", CBS Publishers Delhi

P18PEAU043	**TRANSPORT MANAGEMENT AND MOTOR INDUSTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Motor Vehicle Act and traffic Regulations				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on managing transport systems and to follow the rules and regulations of Motor Industry. Students might able to know the fundamentals and activities of transport systems

COURSE OUTCOMES (COs)

CO1	To know the basics of Transport systems on basis of types, elements and modes
CO2	To know and to understand the transport organization structure and its operations
CO3	To study about geographical conditions, economic factors and operations of transport organization
CO4	To study about the rules and regulations involved in Motor vehicle Act
CO5	To study about the laws and safety precautions developed in order to prevent accidents by 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I INTRODUCTION ON TRANSPORTATION MODES 9

Elements of Mass Transportation, History of transport, modes of transport, types of transport systems

UNIT II TRANSPORT ORGANIZATION AND DEVELOPMENT 9

Transport organization structure, operations, General set up, transport industry, government / (STU) State Government Undertakings and private Bus transport organizations. Bus depot organization structure. Truck fleet operators organization. Economics of Road Transport: Theory of fares and cost of services, fare charging, costing and statistics of operating cost

UNIT III PLANNING FOR NEW TRANSPORT ORGANIZATION 9

Geographical considerations, economic factors, vehicles used, planning of trips. Concept of BRTS operations. Organization of Transport Services: Records and fleet management, vehicles schedule, booking and reservation, statistical records and shipment center, recording of goods transport

UNIT IV MOTOR VEHICLE ACT 9

Acts & definitions, Licensing of drivers and conductors , registration of vehicles, control of transport, RTO and other regulations , offences, penalties and procedures, types of form and procedures, licensing of taxies and buses, rules and regulations, testing and passing of vehicles. Taxation: Structure, method of laying taxation, goods vehicle taxation, passenger vehicle taxation, mode of payment, tax exemption, one / life time taxation. Service Life of vehicles. Toll tax- reasons & operational management. Build Operate Transfer arrangement.

UNIT V ACCIDENT & PREVENTION 9

Vehicle accident, laws, injury, safety precautions, road transport regulations. Insurance & Finance Classes/types of insurance, accident claims and settlements, duty of driver in case of accident, hire purchase.

TEXT BOOK:

1. Motor Vehicles Acts, Law Publishers
2. Myer Kutz, "Handbook of Transportation Engineering", Volume 1: Systems and Operations,Second Edition, Tata McGraw Hill Edition, 2011.
3.Coleman O'Flaherty, "Transport Planning and Traffic Engineering", 4th Edition, Butterworth Heinemann Publications, 2010.
4. Roger P. Roess and Elena S. Prassas, "Traffic Engineering", 4th Edition.

REFERENCES:

1. Schumer, Economics of transport, TMH
2. Fair and Williams, "Economics of transportation", East West Press.
3. Hudson, "Motor transportation", TMH.
4. M.V. Act 1988-RTO rules and regulation manual
5. Fuel Economy of Motor Vehicle, Allied Publishers

P18PEAU043	MANUFACTURING OF AUTOMOTIVE COMPONENTS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Production Technology, Measurements and Metrology				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The objective of this course is to make the students to know and understand the production methods of various engine components like piston, connecting rod, crankshaft etc and various chassis components like friction lining materials, propeller shaft, steering column, gears etc.

COURSE OUTCOMES (COs)

CO1	To know the basics of elastic and plastic and behavior of metals
CO2	To know and to understand the Powder Metallurgy techniques and Plastic processing methods
CO3	To study about Forging and Extrusion process
CO4	To study about the Casting and Machining Process
CO5	To study about the recent trends in manufacturing of automotive components

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I ELASTIC AND PLASTIC BEHAVIOUR OF MATERIALS 9

Elasticity-forms - Stress and strain relationship in engineering materials - Deformation mechanism -Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation, dispersion, fibre and texture strengthening - iron carbon diagram.

UNIT II POWDER METALLURGY AND PROCESSING OF PLASTICS 6

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics.

UNIT III FORGING AND EXTRUSION PROCESS 10

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, and transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, and piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels.

UNIT IV CASTING AND MACHINING 10

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 other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 10

Powder injection molding - 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. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts.

TEXT BOOK

1. Heldt.P.M. “High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.

REFERENCES

1. Haslehurst.S.E. “Manufacturing Technology ", ELBS, London, 1990.
2. Rusinoff, “Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai, 1995.
3. Sabroff.A.M. & Others, "Forging Materials & Processes ", Reinhold Book Corporation, New York, 1988.
4. Upton, "Pressure Die Casting ", Pergamon Press, 1985.
5. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd

PROGRAM ELECTIVE - V

P18PEAU051	VEHICLE BODY ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive chassis, Body Building Technology, Automotive Aerodynamics				

	Course Designed by : Department of Automobile Engineering

OBJECTIVES

The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, paneling of passenger car body trim. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.

COURSE OUTCOMES (COs)

CO1	To Know and to visualize the Car body details with its design and construction
CO2	To Know and to visualize the Bus body details with its design and construction
CO3	To study about the vehicle design on basis to aerodynamic aspects and aesthetic features with safety concerns.
CO4	To Know and to visualize the Commercial vehicle details with its design and construction
CO5	To study about the procedures involved in designing Commercial vehicle pertaining to aerodynamic aspects

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I CAR BODY DETAILS 9

Types of car bodies - visibility: regulation, driver's visibility, methods of improving visibility- safety: safety design, safety aspects. Constructional details of a passenger car.

UNIT II BUS BODY DETAILS 9

Classification of bus bodies – based on distance traveled, based on capacity of the bus and based on style & shape. Types of metal section used in the construction. Construction of Conventional and integral type bus.

UNIT III CAR AERODYNAMICS 9

Objects — Vehicle types of drag. 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. Test with scale models.

UNIT IV COMMERCIAL VEHICLE DETAILS 9

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of driver'sseat in relation to controls. Driver's cab design. Compactness of Driver's cab. Segmental construction of driver's cab.

UNIT V COMMERCIAL VEHICLE AERODYNAMICS 9

Effects of rounding sharp front body edges. Effects of different cab to trailer body Fore body pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicle drag reducing devices. Modern painting process of a commercial vehicle.

TEXTBOOK:

1. Powloski, J., 'Vehicle Body Engineering', Business Books Ltd, 1970
2. J.G. Giles, 'Body Construction and Design', Butterworth and Co., 1975

REFERENCES:

1. John Fenton 'Vehicle Body layout and analysis', Mechanical Engineering Publication Ltd., 1984
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002

P18PEAU052	**TYRE TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Vehicle Design, Vehicle Dynamics, Vehicle Body Building Technology				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

.

COURSE OUTCOMES (COs)

CO1	To Study the basis on Tyre classification and its properties
CO2	To Know the various process involved in the manufacturing of tyre and its fabric preparation
CO3	To Know the process of calendaring, skimming and bead formation with detailed description on process
CO4	To Study the process involved in thread extrusion and bead construction and to know tyre building techniques
CO5	To learn the basics involved in green tyre preparation and 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H

	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

INTRODUCTION TO BASICS OF TYRES 5

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres - Major departments of a Tyre Industry – An explanation of their function and relation to other departments. Factors influencing the performance of tyre: Compound design, degree of mixing: (open mill & internal mixing), parameters (temperature, time, speed), degree of vulcanization - Testing and dispatch of mixes, Basic quality control and mill room control Laboratory.

UNIT I - FABRIC PREPARATION 8

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.

UNIT II - CALENDERING 8

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.

UNIT III - THREAD EXTRUSION AND BEAD CONSTRUCTION 8

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.

UNIT IV - TYRE BUILDING 8

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 tolerance techno-commercial importance of green tyre weight. Green tyre storage considerations.

UNIT V - GREEN TYRE PREPARATION & CURING 8

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.
5. Different tyre manufacturer’s websites.

P18PEAU053	AUTOMOTIVE AERODYNAMICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Vehicle Design, Vehicle Dynamics, Vehicle Body Building Technology				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the

vehicle. In this subject these aspects have been given.						
COURSE OUTCOMES (COs)						
CO1	To know the basics of Aerodynamics, phenomenon and its performance on vehicles					
CO2	To know and to understand theforces acting on a car with its aerodynamic profile development					
CO3	To study about the aerodynamic shape development of a car with optimization techniques					
CO4	To study about the vehicle handling aspects with characteristics of forces and moments					
CO5	To study and to visualize the experimentation on wind tunnels for automotive aerodynamics					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT – I INTRODUCTION **10**

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT – II AERODYNAMIC DRAG OF CABS **8**

Car 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.

UNIT – III SHAPE OPTIMIZATION OF CABS **7**

Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT – IV VEHICLE HANDLING **10**

The origin of force and moments on a vehicle – side wind 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.

UNIT – V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 10

Introduction – Principles 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.

TEXTBOOK:

Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

REFERENCES:

Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
Automotive Aerodynamics: Update SP-706, SAE, 1987.
Houghton, Aerodynamics.

P18PEAU 054	**ELECTRIC AND HYBRID VEHICLES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Automotive Transmission. Automotive chassis, Automotive Electrical systems and Alternative fuels				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

COURSE OUTCOMES (COs)

CO1	To know about the various types of electric vehicles with its design
CO2	To Study the concept of battery with its construction and properties
CO3	To Learn about AC and DC electrical machines
CO4	To Study the configuration and features of electric vehicle drive
CO5	To Study theconfiguration and features 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I ELECTRIC VEHICLES **6**

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNITII BATTERY **7**

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES **8**

Motor and Engine rating, Requirements, DC machines , Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN **12**

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES **12**

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components

REFERENCES :

1. Iqbal Hussain, Electric & Hybrid Vechicles – Design Fundamentals, CRC Press.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles.

OPEN ELECTIVES

		L	T	P	C
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

- Understand the role of business analytics within an organization.

- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in 4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.

Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

		L	T	P	C
P18OEMA002	**INDUSTRIAL SAFETY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

References Books:

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.

		L	T	P	C
P18OEMA002	**OPERATIONS RESEARCH**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques 9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method 9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM 9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming 9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical Analysis and Simulation of Game Theory 9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

		L	T	P	C
P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**				
	Total Contact Hours – 35	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours
Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management 10 Hours
Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT I & AUDIT II

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS

Module I **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module III **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Module VI **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission. Suggested Studies

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able

- to Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and Programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

Module I Introduction 4 Hours

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Module II Repercussions of Disasters and Hazards 4 Hours

Economic Damage, Loss of Humanand Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module III Disaster Prone Areas in India 4 Hours

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module IV Disaster Preparedness and Management 4 Hours

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module V Risk Assessment 4 Hours

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module VI Disaster Mitigation 4 Hours

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS

Module I **8 Hours**
Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module II **8 Hours**
Order, Introduction of roots, Technical information about Sanskrit Literature

Module III **8 Hours**
Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

- Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	AUDIT : VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS

Module I **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

Module II **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module III **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

Module IV **6 Hours**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

Suggested reading

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	AUDIT: CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS

Module I History of Making of the Indian Constitution **4 Hours**
History Drafting Committee, (Composition& Working)

Module II Philosophy of the Indian Constitution **4 Hours**
Preamble, Salient Features

Module III Contours of Constitutional Rights &Duties **4 Hours**
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.

Module IV Organs of Governance **4 Hours**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Module V Local Administration **4 Hours**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO 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

Module VI Election Commission **4 Hours**
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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making
- undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

SYLLABUS

Module I Introduction and Methodology 4 Hours

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

Module II Thematic overview 2 Hours

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module III Evidence on the effectiveness of pedagogical 4 Hours

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV Professional development 4 Hours

Alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module V Research gaps and future directions 2 Hours

Researchdesign,Contexts,PedagogyTeachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading:

a. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
b. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
c. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
d. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic bmaths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
e. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
f. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
g. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT : STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS

Module I 8 Hours

Definitions of Eight parts of yog. (Ashtanga)

Module II: 8 Hours

Yam and Niyam.Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module III 8 Hours

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or

conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

- Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also Improve efficiency

P18ACBA008	AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS

Module I **8 Hours**

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module II

Approach to day to day work and duties. **8 Hours**
ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module III **8 Hours**

Statements of basic knowledge.
ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. ShrimadBhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Suggested Reading

1. Srimad Bhagavad Gita, by Swami SwarupanandaAdvaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity Study of Neetishatakam will help in developing versatile personality of students.

CURRICULUM & SYLLABUS
(R 2018)
CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July, 2018)

M.TECH- THERMAL ENGINNERING

I – IV SEMESTERS

SEMESTER I							
S.No	**Category**	**Code No**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCTE101	Thermodynamics and Combustion	3	0	0	3
2	PC	P18PCTE102	Advanced Fluid Dynamics	3	0	0	3
3	PE		Programme Elective-I	3	0	0	3
4	PE		Programme Elective-II	3	0	0	3
5	PR	P18PRTE103	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCTE1L1	Advanced Thermal Engineering Lab	0	0	4	2
7	PC	P18PCTE1L2	Advanced Heat Transfer Lab	0	0	4	2
AUDIT COURSE							
8	AC	-	Audit Course 1	2	0	0	0
Total				16	0	8	18

SEMESTER II							
S.No	**Category**	**Code No.**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCTE201	Advanced Heat Transfer	3	0	0	3
2	PC	P18PCTE202	Steam Engineering	3	0	0	3
3	PE		Program Elective III	3	0	0	3
4	PE		Program Elective IV	3	0	0	3
PRACTICAL							
5	PC	P18PCTE2L1	Computational Fluid Dynamics Lab	0	0	4	2
6	PC	P18PCTE2L2	Advanced Computational Lab	0	0	4	2
7	PR	P18PRTE2P1	Mini Project with Seminar	0	0	4	2
AUDIT COURSE							
8	AC	-	Audit Course-2	2	0	0	0
Total				14	0	12	18

SEMESTER III							
S.No	**Category**	**Code No.**	**Course Title**	**L**	**T**	**P**	**C**
1	PE		Program Elective V	3	0	0	3
2	OE		Open Elective	3	0	0	3
3	PR	P18PRTE3P2	Dissertation Phase – I	0	0	20	10
Total				6	0	20	16

SEMESTER IV							
S.No	**Category**	**Code No.**	**Course Name**	**L**	**T**	**P**	**C**
1	PR	P18PRTE4P3	Dissertation Phase – II	0	0	32	16
Total				0	0	32	16

Total Credits for the programme = 18 + 18 +16 +16 = 68

LIST OF ELECTIVES

Programme Elective I (PE–I)

S.No	Code No.	Course Title	L	T	P	C
1	P18PETE011	Nuclear Engineering	3	0	0	3
2	P18PETE012	Energy Conservation and Management	3	0	0	3
3	P18PETE013	Advanced Mathematical Method for Thermal Engineers	3	0	0	3

Programme Elective II (PE-II)

S.No	Code No.	Course Title	L	T	P	C
1	P18PETE021	Air Conditioning System Design	3	0	0	3
2	P18PETE022	Gas Turbines	3	0	0	3
3	P18PETE023	Instrumentation for Thermal Engineers	3	0	0	3
4	P18PETE024	Turbo Machineries	3	0	0	3

Program Elective III (PE-III)

S.No	Code No.	Course Title	L	T	P	C
1	P18PETE031	Refrigeration and Cryogenics	3	0	0	3
2	P18PETE032	Design of Heat Exchangers	3	0	0	3
3	P18PETE033	Fundamentals of Pressure Vessels and Piping	3	0	0	3

Program Elective IV (PE- IV)

S.No	Code No.	Course Title	L	T	P	C
1	P18PETE041	Computational Fluid Dynamics	3	0	0	3
2	P18PETE042	Advanced Internal Combustion Engines and Pollution Control	3	0	0	3
3	P18PETE043	Boilers Auxiliaries and Performance Evaluation	3	0	0	3

Program Elective V (PE –V)

S.No	Code No.	Course Title	L	T	P	C
1	P18PETE051	Design of Solar and Wind Power System	3	0	0	3
2	P18PETE052	Advanced Materials Science and Failure Analysis in Thermal Engineering	3	0	0	3

Open Elective (OE)

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OEBA001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	3	0	0	3
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	3	0	0	0

P18PCTE101	**THERMODYNAMICS AND COMBUSTIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Thermal Engineering, Internal Combustion Engines				
	Course Designed by : Department of Mechanical engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

COURSE OUTCOMES (COs)

CO1	Student will get Knowledge of exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics
CO2	Student will be aware about advanced concepts in thermodynamics with emphasis on thermodynamic relations, equilibrium and stability of multiphase multi-component syste
CO3	Student will be aware about the molecular basis of thermodynamics
CO4	Student will acquire the confidence in analyze the motion of combusting and non-combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical non-equilibrium and compressibility
CO5	Student will acquire the confidence in analyze the motion of combusting and non-combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical non-equilibrium and compressibility

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

1	COs/POs	a	B	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

First law and State postulates, Second law and Entropy, Availability and Irreversibility, Transient flow analysis
Nonreactive Ideal-Gas Mixture, PvT Behavior of Real gases and Real Gas Mixture Generalized Thermodynamic Relationship
Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium. Stages of combustion in SI/CI engines

Statistical thermodynamics, statistical interpretations of first and second law and Entropy, Third law of thermodynamics,

References:

- Cengel, "Thermodynamics", Tata McGraw Hill Co., New Delhi, 1980.
- Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.
- Van Wylen & Sonntag, "Thermodynamics", John Wiley and Sons Inc., U.S.A.
- Jones and Hawkings, "Engineering Thermodynamics", John Wiley and Sons Inc., U.S.A, 2004.
- Holman, "Thermodynamics", McGraw Hill Inc., New York, 2002.
- Faires V.M. and Simmag, "Thermodynamics", Macmillan Publishing Co. Inc., U.S.A.
- Rao Y.V.C., "Postulational and Statistical Thermodynamics", Allied Publishers Inc, 1994.

P18PCTE102	**ADVANCED FLUID DYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Fluid Mechanics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

COURSE OUTCOMES (COs)

CO1	Students shall be able to understand and define the fluid flow problems along with range of governing parameters
CO2	Student shall be eligible to take up the fluid flow problems of industrial base.
CO3	Students shall be able to devise the experiments in the field of fluid mechanics
CO4	Students shall be able understand the flow patterns and differentiate between the flow regimes and its effects..
CO5	Students shall be able to understand the different types of fluid flow.

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Properties of Fluids and Governing equations in Fluid Dynamics:Types of fluids. Derivation of Continuity and Momentum equations using integral and differential approach, dimensionless form of governing equations, special forms of governing equations, integral quantities

Solutions of Navier-Stokes Equations: Bernoulli's equation,, Euler's equation developed flows, parallel flow in straight channel, Couette flow, Creeping flows, Dimensionless numbers

Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach, Flow through pipelines and energy losses in pipeflow

Laminar Boundary layers: Boundary layer equations, flow over flat plate, Momentum integral equation for boundary layer, approximate solution methodology for boundary layer equations

Turbulent Flow: Characteristics of turbulent flow, laminar turbulent transition, time mean motion and fluctuations, derivation of governing equations for turbulent flow, shear stress models, universal velocity distribution

Experimental Techniques: Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot Wire Anemometry,

REFERENCES

Muralidhar and Biswas, Advanced Engineering Fluid Mechanics Alpha Science International, 2005

- Irwin Shames, Mechanics of Fluids, , McGraw Hill, 2003
- Fox R.W., McDonald A.T, Introduction to Fluid Mechanics, John Wiley and Sons Inc, 1985
- Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition, 2005

P18PRTE103	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	2	0	0	2
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Understanding that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

COURSE OUTCOMES (COs)

CO1	To understand research problem formulation.
CO2	To analyze research related information
CO3	To understand need of information about Intellectual Property Right to be promoted among students in general & engineering
CO4	To understand the role on growth for individuals and nation
CO5	To know and understand the patent rights

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies

approaches, analysis Plagiarism, Research

ethics,

Unit 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of

Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

4. Mayall , “Industrial Design”, McGraw Hill, 1992. Niebel , “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
7. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

P18PCTE1L1	**ADVANCED THERMAL ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Thermal Engineering, Automotive Engines and Emissions.				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles with performance study of SI and CI engines.

COURSE OUTCOMES (COs)

CO1	To Know and to study the performance aspects of SI and CI engines
CO2	To Study and to determine the Pressure crank angle
CO3	To learn about CMC & PMC Characteristics with its type in detail
CO4	To learn about Heat Balance Test on IC engines
CO5	To study on Assembling and Dismantling of various SI and CI 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS:

1. Trans-esterification and manufacture of biodiesels
2. Performance test on Biodiesels
3. Determination of Thermo Physical Properties of Refrigerants
4. Determination of Heat Transfer Cefficient of Strctured Surfaces and Enhansed Surfaces
5. Boiling and Condensation of Pure and Blend of Refrigerants
6. Performance test on an Air Conditioning Test Rig.
7. Analysis of Valve timings of four stroke engines
8. Analysis of Port timings of two stroke engines.
9. Pollution measurement.

P18PCTE1L2	**ADVANCED HEAT TRANSFER LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	4	2
	Prerequisite – Basic thermal Engg.				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE

Study of the Following Engines and Its Components by Dismantling, Comparing With Recent Engine Components and Assembling Various Parts

Course Outcomes

CO1 – Dismantling procedure of Clutch, Gear Box, Brake system

CO2 – Dismantling procedure of Differential Unit

CO3 – Study and Propeller Shaft Unit

CO4 – Assembling procedure of Clutch, Gear Box, Brake system, Differential 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
2	**CO1**	**H**	**H**	**M**	**H**	**M**
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	47th Meeting of Academic Council-Aug, 2018

:

LIST OF EXPERIMENT:

1. Heat transfer in a pin fin under forced convection mode.
2. Heat transfer from the extended surface
3. Test on Emissivity apparatus
4. Natural convection heat transfer.
5. Thermal conductivity of Insulating Powder
6. Parallel flow Heat Exchanger
7. Counter flow Heat Exchanger
8. Stefan Boltzmann apparatus
9. Thermal conductivity of a specimen using guarded hot plate apparatus.

P18PCTE201	**ADVANCED HEAT TRANSFER**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	0	0	3
	Prerequisite – Basic Mechanical Engineering, Engineering Design, Machine and Component Drawing				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge vehicle frame and suspension, front axle and steering systems, clutch, gear box, drive line and rear axle will be taught to the students.

Course Outcomes

CO1 - The students are expected to understand the subject of Heat Transfer in detail with capability to solve Industrial Problems. This will also create the base and interest among the students to carry out the Future Research

CO2 - The students shall understand different modes of heat transfer

CO3 - The students can solve any practical problems of heat transfer

CO4 – The students shall understand fluidized bed combustion

CO5 – The students shall understand different factors of heat transfer

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M

	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Conduction- one and two dimensional,

Fins, conduction with heat source, unsteady state heat transfer,

Natural and forced convection, integral equation, analysis and analogies,

Transpiration cooling, ablation heat transfer, boiling, condensation and two phase flow mass transfer, cooling, fluidized bed combustion,

Heat pipes, Radiation, shape factor, analogy,
shields, Radiation of gases & vapours.

References:

- J.P. Holman, "Heat Transfer", McGraw Hill Book Company, New York, 1990.
- Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, NewYork, 2000.
- Frank Kreith, "Principles of Heat Transfer", Harper and Row Publishers, New York, 1973.
- Donald Q. Kern "Process Heat Transfer", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.
- Gupta and Prakash, "Engineering Heat Transfer", New Chand and Bros, Roorkee (U.P.) India, 1996.
- R.C. Sachdeva "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., India,

P18PCTE202	**STEAM ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Thermodynamics, Thermal Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

COURSE OUTCOMES (COs)

CO1	Students will have the ability to explain working of different boilers and significance of mountings and accessories.
CO2	Students will have the ability to use techniques, skills, and modern engineering tools necessary for boiler performance assessment.
CO3	Students will have a theoretical and practical background in thermal systems, and will hav good understanding of energy conservation fundamentals. Students will have the ability to analyze thermal systems for energy conservation
CO4	Students will have the ability to design a steam piping system, its components for a process and also design economical and effective insulation.
CO5	Students will have the ability to analyze a thermal system for sources of waste heat design a system for waste heat recovery.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Introduction (7 hrs)

Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers ,Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards

Piping & Insulation (8 hrs)

Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.

Steam Systems (8 hrs)

Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.

Boiler Performance Assessment (8hrs)

Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.

Energy Conservation and Waste Minimization,(5hrs)

Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization

Instrumentation & Control (6hrs)

Process instrumentation; control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection

References:

- T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication
- Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
- Yunus A. Cengel and Boles, “Engineering Thermodynamics “,Tata McGraw-Hill Publishing Co. Ltd
- Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
- Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency
- Edited by J. B. Kitto & S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company
- P. Chatopadhyay; Boiler Operation Engineering: Questions and Answes; Tata McGrawHill Education Pvt Ltd, N Delhi

P18PCTE2L1	**COMPUTATIONAL FLUID DYNAMICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	2	2
	Prerequisite: Basic fluid Mechanics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To provide hands on training on automotive electrical and electronic systems and to provide knowledge on interfacing of different sensors and actuators used in the automobile systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics
CO2	To Know about the Electrical and Electronics Systems with their Characteristics
CO3	To study and to visualize the characteristics of Load cells, thermocouple and Strain gauge
CO4	To study about the Thermometers and Transducers
CO5	To study on the basic programming of Microprocessor and Microcontroller with interfacir 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS:

1. Laminar Flow over Flat plate
2. Laminar Pipe Flow.
3. Steady Flow past a Cylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section.
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Airfoil.
9. Compressible Flow in a Nozzle
10. Partially Premixed Combustion
11. Supersonic Flow over Wedge
12. Bifurcating Artery

P18PCTE2L2	**ADVANCED COMPUTUTIONAL LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Basic CAD lab				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES: To expose the students to have working knowledge on MATLAB or C ++ and analysis tool such as ANSYS

COURSE OUTCOMES (COs)

CO1	The students can program any mathematical model using MATLAB or C ++ or other simulation software's
CO2	To Design and to analyze the Engine components with design calculation and Model Analysis
CO3	To Design and to analyze the Chassis components with design calculation and Model Analysis
CO4	To Design and Analyze the Front and Rear axle systems
CO5	To Design and Analyze the various types of gearboxes

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H

	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

I CYCLE

1. Steady State Conduction in Solid
2. Steady State Convection in Solid
3. Steady State Radiation in Solid
4. Combined conduction and convection
5. Unsteady state conduction and convection
6. Unsteady state conduction and radiation

1. II CYCLE

1. Steady state conduction in Fluids
2. Steady state convection in Fluids
3. Two-phase flows
4. Condensation and boiling heat transfer
5. Solar Radiation Model
6. Energy system simulations

P18PRTE2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				

Course Outcomes:

- Students will get an opportunity to work in actual industrial environment if they opt for internship.
- In case of mini project, they will solve a live problem using software/analytical/computational tools.
- Students will learn to write technical reports.
- Students will develop skills to present and defend their work in front of technically qualified audience.
- Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

P18PRTE3P2	**DISSERTATION PHASE I**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	6	6
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)	
CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria

CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowledge sharing					
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments					
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Core (PC)				
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

P18PRTE4P3	**DISSERTATION PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	12	12
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowled sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

Energy auditing- methodology and analysis, Energy economics, Energy conservation in industries, Cogeneration, Combined heating and power systems, Relevant international standards and laws.

LIST OF ELECTIVES

PROGRAM ELECTIVE - I

P18PETE011	NUCLEAR ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Mechanical Engineering, Power plant Engineering				
	Course Designed by :Department of Mechanical Engineering				

OBJECTIVES

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

COURSE OUTCOMES (COs)

CO1	Student will understand the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing downand absorption.
CO2	The student will also be familiar with concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry
CO3	The student will also be familiar with Time dependent (transient) behaviour of power reactor in non-steady state operation and the means to control the reactor.
CO4	The student will also be familiar with concepts of heat removal from reactor core, reactor safety and radiation protection.
CO5	The student shall understand the fundamental of Nuclear Engineering

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Basics of nuclear fission and power from fission
Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding

Neutron transport and diffusion
Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down

Multi group, multi region diffusion equation, concept of criticality
Solution of multi group diffusion equations in one region and multi region reactors, concept of criticality of thermal reactors

Reactor kinetics and control
Derivation of point kinetics equations, inhour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

Heat removal from reactor core
Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux

Reactor safety, radiation protection
Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

References:

- Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)

- Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)

- Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)

P18PETE012	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Thermal Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

COURSE OUTCOMES (COs)

CO1	The student should acquire insight about the importance of energy
CO2	The student should capable to analyze all scenarios from energy consumption
CO3	The student should generate scenarios of energy consumption and predict the future trend
CO4	The student should Suggest and plan energy conservation solutions
CO5	The student will understand the different types of energy conservations

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.
Energy auditing- methodology and analysis, Energy economics, Energy conservation in industries, Cogeneration, Combined heating and power systems, Relevant international standards and laws.

References:

- L.C. Witte, P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilization”, Hemispherical Publication, 1988.
- Callaghan “Energy Conservation”.
- D.A. Reeg, “Industrial Energy Conservation”, Pergamon Press, 1980.
- T.L. Boyen, “Thermal Energy Recovery” Wiley, 1980.
- L.J. Nagrath, “Systems Modeling and Analysis”, Tata McGraw Hill, 1982.
- W.C. Turner, “Energy Management Handbook “, Wiley, New York, 1982.
- I.G.C. Dryden, “The Efficient Use of Energy “, Butterworth, London, 1982.
- R. Loftnen, Van Nostrarid Reinhold C. “Energy Handbook”, 1978.
- TERI Publications.

P18PETE013	**ADVANCED MATHEMATICAL METHODS FOR THEMAL ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Engineering Mathematics-I, II & III, Numerical methods				
	Course Designed by :Department of Mathematics				

OBJECTIVE : Familiarity with Fourier transformation, properties and applications.To underst the concepts of partial differential equations.To develop the strength to analyze the wave, diffus and Laplace equations using different techniques, Understand the concepts of a random variable a **probability distribution,** use it to solve basic problems arising in physics, mathematics materials science.

COURSE OUTCOMES (COs)

CO1	Identify and solve engineering problems by applying the knowledge of partial differenti equations
CO2	To understand the concepts in Fourier Transforms and to solve the real world problems
CO3	Identify nature of a given wave equation and solve by applying D'Alembert's solution And/or method of solution of method of separation of variables
CO4	To understand the concepts in probability and distributions and to analyse and develop the mathematical model of thermal system
CO5	To solve differential equations for stationary paths, subject to boundary conditions, in straightforward cases.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I FourierTransforms 9 Hrs

Fourier Transforms – Basic properties Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II Partial Differential Equations 9 Hrs

First order partial differential equations; second order linear partial differential equations; Canonical forms; second order equation (Parabolic, Elliptic and Hyperbolic) in rectangular, Solution techniques such as separation of variables, Eigenfunction expansions. D'Alembert's solution forthe Wave equation; Maximum principle for Elliptic equations

UNIT III Discrete and continuous distributions 9Hrs

Binomial, Poisson, Normal, Exponential, Central Limit Theorem and its significance, some sampling distributions like c2, t, F.

UNIT IV Design Of Experiments 9Hrs

One – way, two – way with/without interactions, LatinSquares ANOVA technique, Principles of Design of Experiments, some standard designs such as CRD, RBD, LSD, Some of the relevant topics required for ANOVA (sample estimates and test hypothesis)
May also be included.

UNIT V Calculus of variations 9Hrs

Euler's equation – Variational problems in parametric form – Natural Boundary condition – Conditional Extremum – Isoperimetric problems- Direct methods in Variational problems – Euler's finite difference method – Rayleigh – Ritz Method – Galerkin'smethod.

REFERENCES

1. J.B. Doshi, "Differential Equations for Scientists and Engineers", Narosa, 2010.
2. Peter O'Neil, "Advanced Engineering Mathematics", Seventh Edition, Cengage Learning, 2012 (Indian Edition).
3. Michael Greenberg, "Advanced Engineering Mathematics", Second Edition, Pearson Education, 2002 (Indian Edition).
4. Jennings A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
5. Prem K. Kythe, PratapPuri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
6. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
7. Ramamurthy V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987.
8. Hicks and Turner, Fundamental Concepts in the Design of Experiments, 5th Ed.,
9. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999).

PROGRAMME ELECTIVE – II

P18PETE021	AIR CONDITIONING SYSTEM DESIGN	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nano Technology and its applications, Production Technology , Metallurgy and Manufacturing Process				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in material science with modes of manufacturing process involved in construction of various technologies employed in automobile Industries. Students been focused on basics related to Nano technological developments which sustainably develop their skill in selection of materials for the process of manufacturing.

COURSE OUTCOMES (COs)

CO1	Student should understand construction and design features Air-conditioning system.
CO2	Student should understand various types and its adoptability in the various environment ar application areas
CO3	Student should understand various health issues
CO4	Student should design seasonal energy efficient system
CO5	Student shall understand the design aspects associated with 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Air conditioning systems,various air-conditioning processes,

Enthalpy deviation curve, psychrometry , SHF, dehumidified air quantity, human comfort, indoor air quality,

Design conditions and load calculations, air distribution, pressure drop, duct design, fans &, blowers,Performance & selection, noise control.

CMC & PMC Characteristics, Various types, Advantages & Limitations, Applications. Role of Mixtures- Reinforcement – Particles – Fibres. Carbon/Carbon Composites- Advantages, Limitations- Sol-Gel techniques – Chemical Vapor Deposits. Composite for automotive applications.

References:

- ASHRAE Handbook.
- “Handbook of air-conditioning system design”, Carrier Incorporation, McGraw Hill Book Co.,
- U.S.A, 1965.
- “Refrigeration and air-conditioning”, ARI, Prentice Hall, New Delhi, 1993.
- Norman C. Harris, “Modern Air Conditioning”, New York, McGraw-Hill,1974.
- Jones W.P., “Air Conditioning Engineering”, Edward Arnold Publishers Ltd., London, 1984.
- Hainer R.W., “Control Systems for Heating, Ventilation and Air-Conditioning”, Van Nostrand
- Reinhold Co., New York, 1984. 7. Arora C.P., “Refrigeration & Air Conditioning”, Tata Mc Graw Hill, 1985.
- Manohar Prasad, “Refrigeration & Air Conditioning”, New Age Publishers.
- Stoecker, “Refrigeration & Air Conditioning”, Mc Graw Hill, 1992.
- 10. Stoecker, “Design of Thermal Systems”, Mc Graw Hill, 1992.

P18PETE022	GAS TURBINES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Control of vehicles Systems, Engine and Vehicle Management Systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in safety and comfort systems in automotive vehicles. It also clearly describes the basic ergonomic need in developing various vehicle applications through inputing bio thermal and bio mechanical systems.

COURSE OUTCOMES (COs)

CO1	Student should understand construction and design features of gas turbines as used forpow generation
CO2	Student should understand thermodynamics cycles a, and different sizes and layouts of gas turbine plant
CO3	Able to understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines
CO4	
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Introduction, Cycles, Performance characteristics and improvement,

Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction, Blade materials, manufacturing techniques, blade fixing,

Problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems,

Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

References:

- H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education, 2000.
- V. Ganesan, "Gas Turbines", Tata McGraw Hill, 2003.
- S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
- Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.
- W W Bathic, "Fundamentals of Gas Turbines", John Wiley and Sons.

P18PETE023	**INSTRUMENTATION FOR THERMAL ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines. Automotive chassis, Automotive Electrical systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.

COURSE OUTCOMES (COs)

CO1	Making the student conversant with different working principles of various instruments
CO2	Making the student to learn in the transduction of the signals
CO3	Student can be able to analyze the behavior of an instrument in the measurement process
CO4	Be able to analyze and design an instrumentation system, dealing with the concepts of dynamic range, signal noise ratio, and error budget
CO5	Build, program, calibrate and use a microprocessor-based instrumentation 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

UNIT-1 DISPLACEMENT

Generalized instrumentation system – Error theory – Calibration of instruments – Range – Resolution – Span – Linearity, Sensitivity- Signal conditioning systems.

UNIT-2 INSTRUMENTATION SYSTEM

Static and dynamic characteristics of instruments zero order, first order, second order instruments.

UNIT-3 ERROR ANALYSIS

Error analysis - Uncertainty propagation – Oscilloscope for analysis of dynamic and transient Events.

UNIT-4 MEASUREMENT SYSTEM

Principles and analysis of measurement systems used for measurement of flow, power, pressure, And temperature.

UNIT-5 CONTROL SYSTEM

Basics of control system - Types of control – proportional control, Derivative control, Integral Control, PID control-Programmable logic controllers.

Text book:

1. Doebelin, E.O., *Measurement Systems - Application and Design, 5th* ed., McGraw-Hill,

References:

1. Beckwith, T.G., Buck, L., and Marangoni, R.D., *Mechanical Measurements,* Narosa Pub. House, 1987.
2. Hewlett Packard, *Practical Temperature Measurements* - Application Note 290, 1995.Use of oscilloscope for measurement of dynamic parameters - PV diagram of compressors and I engines - Comparison of flow measuring instruments - Measurement of static and dynamic characteristics of instruments.

P18PETE024	TURBO MECHINERIES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – IC Engines and Emissions, Automotive Engines and Combustion Characteristics,				
	Course Designed by- Department of Mechanical 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.

Course Outcomes

CO1 Able to derive the basic equations used for turbo machines

CO2 Will be able to understand the concept of velocity triangles used for performance evaluation of Turbines

CO3 Able to understand the concept of degree of reaction for axial flow compressors

CO4 Will able to understand the basic concepts of gas dynamics

CO5 Analyze the performance of axial flow gas 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	H	M	H		H	M	H	H	H	H	M	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	H		L	M		H	L	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 (H)
						√			
4	Approval	47th Meeting of Academic Council-Aug, 2018							

Syllabus:

UNIT-1
Introduction and cascades – Two-dimensional cascades – Analysis of cascade forces – Energylosses – Cascade correlation – Off design performance – Dynamics of Fluid flow & Basic equations

UNIT-2
Power generating machine I - Axial flow turbines- Stage losses and efficiency – Soderberg'scorrelation – Turbine flow characteristics. Tangential flow turbines.

UNIT-3 Power absorbing machine I - Axial flow compressors – Three dimensional flowin axial turbo machines – theory of radial equilibrium – actuator disc approach – Secondary flows

UNIT-4 Power absorbing machine II - Centrifugal pumps, fans, and compressors – slip factor – optimumdesign of centrifugal compressor inlet choking in a compressor stage. Reciprocating pumps.

UNIT-5
Power generating machine II - Radial flow turbines, Loss coefficients – off design operating condition – clearance and windage losses 90 deg IFR turbines.

Text book:
1. Csanady, G.T., *Theory of Turbo machines,* McGraw Hill, 1964.

References:

1. Dixon, S.L., *Fluid Mechanics and Thermodynamics of Turbo machinery, 5th* ed.Butterworths Heinemann, 2005.
2. Prithvi Raj, D. and Gopalakrishnan, G., *A Treatise on Turbo machines*, SciTechPublication, 2003.

PROGRAM ELECTIVE-III

P18PETE031	REFRIGERATION AND CRYOGENICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Thermal Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge CAD procedures and acquire skills in designing and development of a product.

COURSE OUTCOMES (COs)

CO1	To learn the basics of refrigeration and cryogenics and its application area.
CO2	To design the refrigeration systems for domestic and industrial applications like cold storages
CO3	To learn about ODP, GWP and related environment issues
CO4	To learn about different types Refrigeration system.
CO5	To learn about the principles of cryogenics.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Vapour compression refrigeration, actual cycle, second law efficiency,

Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems,

Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor,

Design, selection of evaporators, condensers, control systems, motor selection, Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,
Refrigeration applications, food preservation, transport,

Introduction to Vapor absorption refrigeration, single effect and double effect systems, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle.

References:

- R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2001.
- C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
- Stoecker & Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, New York, 1982.
- Jordan & Priester, "Refrigeration and Air-conditioning".
- A.R.Trott, "Refrigeration and Air-conditioning", Butterworths, 2000.
- J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.
- R.Barron, "Cryogenic systems", McGraw–Hill Company, New Yourk, 1985.

- G.G.Hasseldon. "Cryogenic Fundamentals", Academic Press.
- Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.
- W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
- John A.Corinchock, "Technician's Guide to Refrigeration systems", McGrawHill.
- P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan, 1992.
- ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
- Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics", Clarendon Press, 1989

P18OETE032	DESIGN OF HEAT EXCHANGER	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Thermal Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

COURSE OUTCOMES (COs)

CO1	Students will demonstrate a basic understanding of several types of heat exchangers that w include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes
CO2	Students will design and analyses of shell-and-tube double pipe, compact, plate heat exchangers
CO3	Students will demonstrate the performance degradation of heat exchangers subject to fouling.
CO4	Students will understand the different types of Heat exchangers
CO5	Students will understand the different design aspects of Heat exchangers

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	H	H	M
	CO2	H	H	L	M	H
	CO3	H	M	H	M	L
	CO4	M	H	L	H	H
	CO5	H	M	L	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47 th Meeting of Academic Council, 2018				

Syllabus:

Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.

Heat exchanger design methodology, assumption for heat transfer analysis, problem formulation, e-NTU method, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.
Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop

Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger

Shell and Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers

Mechanical Design of Heat Exchangers – design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. Introduction to simulation and optimization of heat exchangers, flow induced vibrations.

References:

- Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
- D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.
- Sadik Kakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
- A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
- Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".
- T. Kuppan, "Hand Book of Heat Exchanger Design".
- "T.E.M.A. Standard", New York, 1999.
- G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982.

P18PETE033	FUNDAMENTAL OF PRSSURE VESSELS AND PIPING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Mechanical Engineering, Automotive Engines and sub systems				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge on various pollutants causing emissions in SI ad CI engine. It also helps to know about various test procedures to be carried out in determining SI and CI engine Emission with its control techniques.

Course Outcomes

CO1 Will understand the different types of stresses and their effects in pressure vessel

CO2 - Will understand the piping layout and the stresses acting on it.

CO3 To understand the piping layout and the stresses acting on it.

CO4 To understand the different types of stresses and their effects in pressure vessel

CO5 – To understand the different types of piping 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
2	CO1	H	M	H		H	M	H	H	H	H	H	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	M		L	H		H	L	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 (H)
					√				

4	Approval	47th Meeting of Academic Council-Aug, 2018

Syllabus:

UNIT I INTRODUCTION PRESSURE VESSELS & STRESS PATTERNS 9

Methods of determining stress – (1) strain gauges (2) photo elastic method (3) moiré fringe techniques terminology – ligament efficiency – applications.

UNIT I STRESSES IN PRESSURE VESSLES 9

Introduction – Hoop, longitudinal & radial stresses – general theory of maintain stresses – thin & thick cylinders – shell components – cylindrical shells – vessel heads – thermal stresses – discontinuity stresses in pressure vessels. Shrink fit – auto fuettage – ultrahigh pressure vessel design. Bursting pressure.

UNIT I DESIGN OF VESSELS 9

Design of Tall cylindrical self supporting process column – supports short vertical vessels – stress concentration – variable thickness transition section in cylindrical vessels. Circular hole – elliptical openings – theory of reinforced openings – Bolted & Welded joints – Design criteria & codes.

UNIT I BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9

Buckling phenomenon – Elastic budding of circular ring and cylinders under external pressure – collapse of thick walled cylinders of tubes under external pressure – effect of supports on elastic buckling of cylinders – inelastic collapse – Bulking under combined external pressure and axial loading. Interaction method.

UNIT V PIPING 9

Introduction – Flow diagram – piping layout and piping stress analysis

References:

1. JOHN. F. HARVEY. 'Theory and Design of Pressure Vessels.' CBSD Distribution 1987.
2. HENRY. H. BENDER. "Pressure Vessel Design Hand Book CBSD Publication and distributors 1987.
3. WILLIAM J. BEES 'Approximate methods design and analysis of pressure vessels and piping'. Piping Conference 1997

PROGRAM ELECTIVE - IV

P18PETE041	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Fluid Mechanics, Thermodynamics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on studying the various methods of processes involved inAutomotive Air-Conditioning Systems. The students can able to understand the concepts involved in various cycles of refrigeration and heating.

COURSE OUTCOMES (COs)

CO1	The students are expected to understand the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.
CO2	Students shall understand the various governing equation associated with CFD
CO3	Students shall understand the applications of CFD
CO4	Students shall understand the principles of CFD
CO5	Students can apply CFD knowledge in their project works.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Introduction to CFD: with experimental and Hyperbolic Equations Computational approach to Fluid Dynamics and its comparison analytical methods, Basics of PDE: Elliptic, Parabolic

Governing Equations: Review of Navier-Stokes Equation and simplified forms, SolutionMethodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Finite Volume Method: Domain discretization, types of mesh and quality of mesh,SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach

Geometry Modeling and Grid Generation: Practical aspects of computational modelingof flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance

Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for DiffusionEquation, Convection Equation and Convection-Diffusion Equation

Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-ImplicitAlgorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

References:

- Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw Hill International editions, Mechanical Engineering series.
- Numerical Methods in Fluid Flow & Heat Transfer by Dr. Suhas Patankar.
- An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall
- Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
- An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
- Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

P18 PETE042	ADVANCED INTERNAL COMBUSION ENGINES AND POLLUTION CONTROL	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines and Emissions, Engineering Chemistry, Automotive Pollution and its control, Fuels and Combustion.				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Understand the basic concept and to involve in replenishing the world through utilization of alternative fuels to meet over the current demand on energy scenario. The students can able to know the various alternative sources of energy other than fossil fuels and their significance.

COURSE OUTCOMES (COs)

CO1	Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle
CO2	Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine's performance
CO3	To Demonstrate the delay period and fuel injection system
CO4	Demonstrate an understanding of the relationships between the design of the IC engine and environmental and social issues
CO5	Analyze problems involving steady state heat conduction in simple geometries

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	47th Meeting of Academic Council-Aug, 2018

Syllabus:

UNIT-1 OPERATING PARAMETERS & THERMO CHEMISTRY 9

Engine design and operating parameters – Thermo chemistry of fuel air mixtures- properties of working fluids.

UNIT-2 ENGINE CYCLES & CYCLE ANALYSIS 9

Ideal model of engine cycles – cycle analysis with constant specific heats – Volumetric efficiency– Super charging and Turbo charging

UNIT-3 FUEL INTAKE & INJECTION SYSTEM 9

Fuel intake systems and combustion in SI and CI engines – Carburetor and fuel injection systems –Squish -prechamber engine flows.

UNIT-4 POLLUTANT FORMATION & CONTROL 9

Pollutant formation and control in IC engines - Types of diesel combustion system – Fuel spray behavior – Ignition delay.

UNIT-5 ENGINE OPERATING CHARATERISTICS 9

Engine friction and lubrication – measurement of friction – fluid mechanics based multi dimensional models – Engine operating characteristics.

Text book:

1. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.
2. Ganesan, V., Internal Combustion Engines, 2nd ed., Tata McGraw-Hill, 2003.

References:

Taylor, C.P., The Internal Combustion Engines in Theory and Practice, Vol-2, MIT press,1985.

P18PETE043	BOILERS AUXILIARIES AND PERFORMANCE EVALUATION	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive Engines and Emissions, IC engines and Alternative Fuels, Automotive Electronics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To explain the principle of engines electronic management system and different sensors used in the systems.

COURSE OUTCOMES (COs)

CO1	Understand the concepts of boiler and methods of improving efficiency boiler
CO2	Understand the types of fuel and ash handling devices.
CO3	Understand the types of pumps and fans and associated selection principles
CO4	Understand the selection and criteria of dust cleaning equipments
CO5	Understand the Various types and operation of soot blowers

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

UNIT-1 BOILER TYPES & EFFICIENCY 9

Boiler types - Efficiency calculation - Balance diagram – Boiler start up calculations –Boiler turbine matching – Power Plant balance diagram

UNIT-2 FUEL & ASH HANDLING EQUIPMENTS 9

Fuel and Ash handling Equipment – Crushers and Mills - Drum internals - Specification and selection.

UNIT-3 PUMPS & FANS 9

Feed pumps – Different types, Specifications, Operation and maintenance aspects - Fans, blowers– Applications – Performance requirements, Selection, Operation and maintenance.

UNIT-4 DUST CLEANING EQUIPMENTS 9

Dust cleaning equipment – Selection criteria – Design, operation and maintenance of electrostatic precipitators, Bag filters.

UNIT-5 SOOT BLOWERS 9

Soot blowers – Various types and their constructional features – Specifications – Selection – Operation and Maintenance.

Text book:

Shields, C.D., Boilers, Types Characteristics and Functions, McGraw-Hill, 1961.

References:

1. Modern Power Station Practice, CEGB London, Pergamon Press, 1991.
2. Eck, B., Fans, Pergamon Press, 1973.

PROGRAM ELECTIVE -V

P18PETE051	DESIGN OF SOLAR AND WIND POWER SYSTEM	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nanotechnology, Mechanics of Materials and Automotive Chassis				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Know about the Noise, Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles.

COURSE OUTCOMES (COs)

CO1	should update about the technological status of implementation of NCES in India
CO2	Student should capable to analyze various techno economical obstacles in the commercial development of NCES in India
CO3	Student should capable to conceptually model and design general NCES systems and pred the long term performance
CO4	Student should suggest and plan hybrid NCES solutions to conventional energy systems
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Syllabus:

Conventional sources of energy, Nuclear, Alternative energy sources,

Solar Radiation-estimation, prediction & measurement, Solar energy utilization,

Performance of Solar flat plate collectors, concentrating collectors, thermal storage,
Wind energy, Direct Energy conversion- PV, MHD,
Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.

References:

- D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor and Francis, 2000.
- Sukhatme S.P., "Solar Energy", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
- Bansal and othes, "Non-Conventional Energy Sources".
- J.F. Kreider, F. Kreith, "Solar Energy Handbook", McGraw Hill, 1981
- J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley, 1991.

P18PETE052	**ADVANCED MATERIALS SCIENCE AND FAILURE ANALYSIUS IN THERMAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Motor Vehicle Act and traffic Regulations				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on managing transport systems and to follow the rules and regulations of Motor Industry. Students might able to know the fundamentals and activities of transport systems

COURSE OUTCOMES (COs)

CO1	To understand the various types of Mechanical Engineering materials
CO2	Understanding the Mechanism of Elastic and Plastic deformation of Materials.
CO3	To understand the various types of failure of Materials and the Mechanism of failure
CO4	To understand the design principles of bodies which are subjected to Static load
CO5	To understand the design principles of bodies which are subjected to variable loads

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

1	COs/POs	a	b	c	d	e

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I. STRUCTURE, PROPERTIES AND APPLICATION OF ENGG. MATERIALS 9

Metals, Alloys, Ceramics & Glasses, Organic Polymers, Smart materials, Super alloys,
Shape memory alloys, Nano materials, Super hard cutting tool materials, Crystalline and Non crystalline states Composite Materials.

UNIT II ELASTIC & PLASTIC DEFORMATION OF MATERIALS 9

Point imperfection, Dislocations, Surface imperfection, Stress-Strain curve, Dislocation motion analysis.

UNIT III. FAILURE ANALYSIS OF MATERIALS 9

Types of failure of materials, Creep, Fatigue, Fracture analysis. Mechanism of failure and
Methods of protection against failure. Failure resistant materials.

UNIT IV THERMAL STRESSES AND STRAINS

Principles of thermal stresses and strains and application in practical problems

UNIT V DESIGN AGAINST STATIC AND VARIABLE LOAD 9

Factor of safety, Principal plane and principal stresses, Endurance limits, S-N curve, Types of variable stress Soderberg equation, Goodman equation,
Gerber equation.

BOOKS:

1. Failure of materials in Mechanical design by J.A.Collins, A Wiley - Interscience publication. copyright@1981 by John Wiley & Sons, Inc.
2. Material science and Engineering by V.Raghavan, 5th edition, 2012,
published by Asoke K.Ghush, PHI Learning pvt. Ltd.
3. Design of Machine elements, 3rd edition by V.B.Bhandari,
Tata.McGraw Hill education pvt. Ltd., New Delhi.
4. The Science and Engineering of materials, SI Edition, Donald R. Askeland, Pradeep P. Fulay, Wendelin J.

OPEN ELECTIVES

		L	T	P	C
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics **9 Hours**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis **9 Hours**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics **9 Hours**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive

analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in 4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

		L	T	P	C
P18OEMA002	**INDUSTRIAL SAFETY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

References Books:

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.

		L	T	P	C
P18OEMA002	**OPERATIONS RESEARCH**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques 9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method 9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM 9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming 9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical Analysis and Simulation of Game Theory 9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management 10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
6.

		L	T	P	C
P18OEME005	**COMPOSITE MATERIALS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.

Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and

		L	T	P	C
P18OEEE006	**WASTE TO ENERGY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT I & AUDIT II

P18ACEN001	AUDIT : ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS

Module I **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II **4 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module III **4 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV **4 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V **4 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Module VI **4 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission. Suggested Studies

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .

4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able

- to Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and Programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

Module I Introduction 4 Hours

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Module II Repercussions of Disasters and Hazards 4 Hours

Economic Damage, Loss of Humanand Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module III Disaster Prone Areas in India 4 Hours

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module IV Disaster Preparedness and Management 4 Hours

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module V Risk Assessment 4 Hours

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning,

People's Participation in Risk Assessment. Strategies for Survival.

Module VI Disaster Mitigation **4 Hours**

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	AUDIT : SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS

Module I **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module II **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

Module III **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

- Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	AUDIT : VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS

Module I **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

Module II **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module III **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

Module IV **6 Hours**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

Suggested reading

1.Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	AUDIT: CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS

Module I History of Making of the Indian Constitution **4 Hours**

History Drafting Committee, (Composition& Working)

Module II Philosophy of the Indian Constitution **4 Hours**

Preamble, Salient Features

Module III Contours of Constitutional Rights &Duties **4 Hours**

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.

Module IV Organs of Governance **4 Hours**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges,

Qualifications, Powers and Functions

Module V Local Administration **4 Hours**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO 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

Module VI Election Commission **4 Hours**

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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making
- undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

SYLLABUS

Module I Introduction and Methodology 4 Hours

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

Module II Thematic overview 2 Hours

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module III Evidence on the effectiveness of pedagogical 4 Hours

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV Professional development 4 Hours

Alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module V Research gaps and future directions 2 Hours

Researchdesign,Contexts,PedagogyTeachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading:

a. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
b. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
c. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
d. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic bmaths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
e. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
f. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
g. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions,

and with what population of learners?

- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	AUDIT : STRESS MANAGEMENT BY YOGA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS

Module I **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

Module II: **8 Hours**

Yam and Niyam.Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module III **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

- Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also Improve efficiency

P18ACBA008	AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS

Module I **8 Hours**

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module II

Approach to day to day work and duties. **8 Hours**

ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module III **8 Hours**

Statements of basic knowledge.
ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. ShrimadBhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Suggested Reading

1. Srimad Bhagavad Gita, by Swami SwarupanandaAdvaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity Study of Neetishatakam will help in developing versatile personality of students.

CURRICULUM AND SYLLABUS
(R2018)

CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July, 2018)
M.TECH – COMPUTER AIDED DESIGN

I – IV SEMESTERS

SEMESTER – I							
S.No	**Category**	**Code**	**Subject Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCCD101	Fundamentals of Stress Analysis	3	0	0	3
2	PC	P18PCCD102	Computer Graphics	3	0	0	3
3	PE		Program Elective-I	3	0	0	3
4	PE		Program Elective-II	3	0	0	3
5	PR	P18PRCD101	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCCD1L1	Advanced Mechanical Design Lab	0	0	4	2
7	PC	P18PCCD1L2	Advanced CAD Lab	0	0	4	2
AUDIT COURSE							
8	AC		Audit Course – 1	2	0	0	0
			Total	16	0	8	18

SEMESTER – II

S.No	Category	Code	Subject Name	L	T	P	C
THEORY							
1	PC	P18PCCD201	Finite Element Analysis	3	0	0	3
2	PC	P18PCCD202	Computer Aided Design	3	0	0	3
3	PE		Program Elective –III	3	0	0	3
4	PE		Program Elective – IV	3	0	0	3
PRACTICAL							
5	PC	P18PCCD2L1	Advanced Automation, Robotics And Control Lab	0	0	4	2
6	PC	P18PCCD2L2	Advanced Computer Aided Modelling, Analysis and Optimization Lab	0	0	4	2
7	PR	P18PRCD2P1	Mini Project with Seminar	0	0	4	2
AUDIT COURSE							
8	AC		Audit course – 2	2	0	0	0
			Total	14	0	12	18

SEMESTER – III

S.No	Category	Code	Subject Name	L	T	P	C
1	PE		Program Elective – V	3	0	0	3
2	OE		Open Elective	3	0	0	3
3	PR	P18PRCD3P2	Dissertation Phase – I	0	0	20	10
			Total	6	0	20	16

SEMESTER – IV

S.No	Category	Code	Subject Name	L	T	P	C
1	PR	P18PRCD4P3	Dissertation Phase – II	0	0	32	16
			Total	0	0	32	16

Total Credits for the Programme = 18 + 18 + 16+ 16 =68

LIST OF ELECTIVES

Programme Elective I (PE I)

S.No.	Code	Subject Name	L	T	P	C
1	P18PECD011	Engineering Design	3	0	0	3
2	P18PECD012	Design Concepts for Manufacturing and Assembling	3	0	0	3
3	P18PECD013	Advanced Mathematical Methods for CAD Engineers	3	0	0	3

Programme Elective-II (PE II)

S.No.	Code	Subject Name	L	T	P	C
1	P18PECD021	Advanced Integrated Product Design and Development	3	0	0	3
2	P18PECD022	Multi Body Dynamics and Application	3	0	0	3
3	P18PECD023	Advanced Mechanical Vibration and Acoustics	3	0	0	3

Programme Elective-III (PE III)

S.No.	Code	Subject Name	L	T	P	C
1	P18PECD031	Tribology	3	0	0	3
2	P18PECD032	Robotics and Control	3	0	0	3
3	P18PECD033	Fundamentals of Fracture Mechanics	3	0	0	3

Programme Elective-IV (PE IV)

S.No.	Code	Subject Name	L	T	P	C
1	P18PECD041	Optimization Techniques in Design	3	0	0	3
2	P18PECD042	Rapid Prototyping	3	0	0	3
3	P18PECD043	Design of Pressure Vessel and Piping	3	0	0	3

Programme Elective-V (PE V)

S.No.	Code	Subject Name	L	T	P	C
1	P18PECD051	Advanced Finite Element Analysis	3	0	0	3
2	P18PECD052	Advanced Materials Science and Failure Analysis	3	0	0	3

List of Open Electives (OE)

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	3	0	0	3
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

P18PCCD101	FUNDAMENTALS OF STRESS ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Mechanics of Solids				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in various types of stresses in mechanical elements and to find the optimal shape of mechanical elements.

COURSE OUTCOMES (COs)

CO1	Students will understand the tonsorial approach of continuum mechanics and comprehend modern research material.
CO2	Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship.
CO3	Students will be able to apply basic field equations to torsion, bending and two dimensional elasticity problems, and energy methods.
CO4	Students will be able to solve problems in unsymmetrical bending and shear center, contact stresses and pressurized cylinders and rotating discs.
CO5	To Learn about different types of stresses and to design optimum shaped mechanical 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Theory of Elasticity

Analysis of stress, Analysis of stain, Elasticity problems in two dimension and three dimensions, Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates.

Unit 2. Energy Methods

Energy method for analysis of stress, strain and deflection **T**he three theorem's -theorem of virtual work, theorem of least work, Castiglioni's theorem, Rayleigh Ritz method, Galekin's method, Stress – strain curves .

Unit 3. Theory of Torsion

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy.Torsion of solid and hollow shafts Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping.

Unit 4. Unsymmetrical Bending and Shear Centre

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section. .

Unit 5. Pressurized Cylinders ,Rotating Disks and contact stresses

Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc**.**

Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area.

REFERENCES:

Sadd, Martin H., Elasticity: Theory, applications and Numeric, Academic Press 05 (Text Book)

Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 00

Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999

Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991

Theory of Elasticity – Timoshenko and Goodier, Mc Graw Hill

Advanced Strength of Materials, Vol. 1,2 – Timoshenko, CBS

Advanced Strength of Materials – Den Harteg

P18PCCD102	COMPUTER GRAPHICS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

COURSE OUTCOMES (COs)

CO1	Understand geometric transformation techniques in CAD
CO2	Develop mathematical models to represent curves
CO3	Design surface models for engineering applications
CO4	Model engineering components using solid modeling techniques
CO5	Design and analysis of engineering components

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I

BASICS

Graphics & Design-User interfaces – Graphic hardwares-Work stations –Processors-Displays-Input devices-Hard copy devices-graphic software-Co-ordinates – Functions-Standards.

UNIT II **9**

GEOMETRIC TRANSFORMATION

Output primitives-Points & Lines-DDA & Bresenham's algorithms-Circles –Mid point algorithms-Geometric transformations-scaling-Translation-rotation-Shearing-Reflection-concatenation.

UNIT III **9**

GEOMETRIC MODELING

Geometric modeling-Wire frame models-Parametric representation of analytic curves Synthetic curves-Bezier curves-Cubic splines-B-splines –Surface models-Analytic surfaces-Bezier surfaces-Coon surfaces-Triangular patches.

UNIT IV **9**

SOLID MODEL REPRESENTATION

Solid models-Representations-Boundary representation-Constructive Solid Geometry-Analytical solid modeling-Modeling packages.

UNIT V **9**

DATABASE AND DOCUMENTATION

Graphic standards-Graphic Kernel system-Database-Working Co-ordinate system -Model Co-ordinate system-Screen Co-ordinate system –Documentation-IGES-Data representation-File structure & Format-Processors.

TEXT BOOKS:

1. M.Pauline Baker,Donald Hrarn-Computer Graphics-Prentice Hall of India 1993.

REFERENCES:

1. Ibrahim Zeid-CAD CAM Theory & Practice-McGraw Hill 1998

P18PRCD103	RESEARCH METHODOLOGY AND IPR	L	T	P	C
	Total Contact Hours: 60	2	0	0	2
	Prerequisite:				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

- Understanding that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

COURSE OUTCOMES (COs)

CO1	To understand research problem formulation.
CO2	To analyze research related information
CO3	To understand need of information about Intellectual Property Right to be promoted among students in general & engineering
CO4	To understand the role ongrowth for individuals and nation
CO5	To know and understand the patent rights

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
						√
4	Approval	47th Meeting of Academic Council-Aug, 2018				

.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics ofa good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches,

analysisPlagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patentinformation and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

P18PCCD1L1	ADVANCED MECHANICAL DESIGN LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Mechanics of Solids				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles with performance study of SI and CI engines.

COURSE OUTCOMES (COs)

CO1	To Know and to study the performance aspects of SI and CI engines
CO2	To Study and to determine the Pressure crank angle
CO3	To learn about CMC & PMC Characteristics with its type in detail
CO4	To learn about Heat Balance Test on IC engines
CO5	To study on Assembling and Dismantling of various SI and CI 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS

1. Kinematics analysis of Four Bar mechanism.
2. Kinematics analysis of Slider Crank,
3. Analysis of quick return mechanism.
4. Vibration measurement using electro dynamic pickup.
5. Vibration measurement using oscilloscope
6. Determination natural frequency using dunkerleys rules and experimental verification.
7. Dynamic analysis of cantilever beam using **C** programming / MAT lab

8. Determination of natural frequency of a solid shaft using computer programming / MAT lab
9. Determination of natural frequency of simple machine elements using theoretical and experimental and simulation techniques.
10. Determination of critical speed of rotating shaft
11. Design of machine elements using MAT lab and C programming.
12. Design of structural components using MAT lab software /computer programming.

P18PCCD1L2	**ADVANCED CAD LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	0	0	4	2
	Prerequisite : Basic CAD lab				
	Course Designed by- Department of Automobile Engineering				

OBJECTIVE

Study of the Following Engines and Its Components by Dismantling, Comparing With Recent Engine Components and Assembling Various Parts

Course Outcomes

CO1 – Dismantling procedure of Clutch, Gear Box, Brake system

CO2 – Dismantling procedure of Differential Unit

CO3 – Study and Propeller Shaft Unit

CO4 – Assembling procedure of Clutch, Gear Box, Brake system, Differential 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
2	CO1	H	H	M		H	M	M	M	H	H	H	H
	CO2									M			
	CO3		H	H	M	H	H	H		H		M	H
	CO4	H					L		M		M		
	CO5			H		H		M		M		M	M
	CO6	L	M	M		M	L		L	M	M	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

The lab course would expose the students to Design , Geometric modelling and assembly in a CAD environment using tools used in industry like CATIA / NX / PTC Creo / Solid Works / Inventor etc. Toward the end of this course students should be able to do design and model the various types of structural and machine elements

List of Experiments (Indicative)

1. 2D view sketches and solid models of shaft support, machine block, sliding block & support, bearing bracket, vice-body, depth stop & flange connector and other machine elements [Design tree, visualisation tools, command and GUI managers, units etc.; Sketcher tools – profiles, dimensional & geometric constraints, transformation tools, coordinate systems etc.]

2. Design and Solid modelling and assembly of shafts , sleeve coupling , flange coupling and Universal coupling etc – use design tables/macros [Solid modeling –Sketch based features like extrude, revolve, sweep, etc and variational sweep, loft, etc., dress based features like fillet, chamfer, draft, shell etc. Boolean operations etc. design table macros, formulas and other design automation tools, mass property calculations, multibody features, functional modelling etc. Assembly modelling : Assembly planning - Insert, position and orientation, assembly mating and simulation, interference and assembly analysis, assembly properties like CG etc., assembly approaches

3. Solid modelling, assembly and drafting with GD&T of a tool post Drafting – standard views, dimensioning, layouts, GD&T, Bill of materials, exploded views etc]

4. Solid modelling, assembly of a windmill and a study of assembly interference

5. Surface modelling of car body etc

6 Creation of surfaces from reverse engineered data from a toy car

7. Preparation of a CAD model of an aerofoil for FEA/CFD analysis For the above exercises make a professional CAD documentation for professional product presentations.

8. Other Design , 3D modeling and assembly diagrams of piston, connecting rod assembly etc.

P18PCCD201	FINITE ELEMENT ANALYSIS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Mechanics of Solids,Machine Design				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

COURSE OUTCOMES (COs)

CO1	To Know and to study about Clutch and Gearbox with its type in detail
CO2	To Study on various types of hydrodynamic torque transmission and its performance characteristics
CO3	To Know about Automatic Transmission and its type in detail
CO4	To learn the principle of Hydrostatic and Electric drive system elaborately
CO5	To study on applications of Automatic Transmission with its characteristics

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT -1
BASIC CONCEPTS **12**

Field problems – elementary treatments – Elements & types – Mathematical modeling – Steady state problems – Progagation problems – Eigen value problems – Differential formulation – Variational methods – weighted residual methods – Convergence criteria – Error estimation.

UNIT – II
PROCEDURES & INTERPOLATIONS **12**

Bar element - Mechanical & Thermal loads – Steps – Discretization – Element formulation – Connectivity – Global equation – Boundary conditions – Essential & natural b.c. – solution – Post processing – Shape functions – Lagrange interpolation – Temperature & strain distributors – Heat transfer.

UNIT III
ELASTICITY PROBLEMS **12**

Elasticity concepts – plane stress & strain – Element stiffness matrix – Strain – Displacement relations – Material property matrix – Constitutive relation ship – Nodal forces using equilibrium – Euler – Bernouli beam elements – Trusses & Frames.

UNIT IV
ISOPARAMETRIC FORMULATION **12**

Node numbering – Transformations – Natural Co-ordinates – Approximation of geometry – Isoparametric formulation – Gauss quadrature – Choice of quadrature rule – Stress calculation – Gauss point.

UNIT V
THREE DIMENSIONAL PROBLEMS ***12***

3-D problems & analysis – Applications – Computerized FEA – Preprocessing Mesh generation – Element types – Solution – Post processing – Case studies .

Total Periods: 45

References:

1. J.N. Reddy – An introduction to finite Element methods – Mc Graw Hill 1993.
2. K.J. Bathe – Finite Element procedure – Prentice Hall of India 1997
3. O.C. Zienkiewicz – The Finite Element Methods – Me Graw Hill 1989.
4. T.R. Chandraputta A. D. Belegundu – introduction to Finite Elements in Engineering Prentice Hall of India . 1997

P18PCCD202	COMPUTER AIDED DESIGN	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Machine Design, Automotive Chassis				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

COURSE OUTCOMES (COs)

CO1	To Know and to study about Clutch and Gearbox with its type in detail
CO2	To Study on various types of hydrodynamic torque transmission and its performance characteristics
CO3	To Know about Automatic Transmission and its type in detail
CO4	To learn the principle of Hydrostatic and Electric drive system elaborately
CO5	To study on applications of Automatic Transmission with its characteristics

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: CAD Hardware and Software, Types of systems and system considerations, input and

output devices, hardware integration and networking, hardware trends, Software modules,

Unit 2: Computer Communications, Principle of networking, classification networks, network

wring, methods, transmission media and interfaces, network operating systems,

Unit 3: Computer Graphics Introduction, transformation of geometric models: translation,scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping;

Unit 4 : Projections of geometric models, orthographic projections, Geometric Modeling, curverepresentation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation,Fundamentals of solid modeling, boundary representation (B-rep), Constructive SolidGeometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc.

Unit 5: Finite Element Modeling and Analysis, Finite Element Analysis, finite elementmodeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, types of models, types of simulation approaches

References:

Ibrahbim Zeid, "CAD / CAM Theory and Practice".

Jim Browne, "Computer Aided Engineering and Design".

P. Radhakrishnan / V. Raju / S. Subramanyam, "CAD / CAM / CIM".

P.N. Rao, "CAD / CAM principles and applications", Tata Mcraw-Hill, 02.

P18PCCD2L1	**ADVANCED AUTOMATION, ROBOTICS AND CONTROL LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Basic Mechatronics.				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To provide hands on training on automotive electrical and electronic systems and to provide knowledge on interfacing of different sensors and actuators used in the automobile systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics
CO2	To Know about the Electrical and Electronics Systems with their Characteristics
CO3	To study and to visualize the characteristics of Load cells, thermocouple and Strain gauge
CO4	To study about the Thermometers and Transducers
CO5	To study on the basic programming of Microprocessor and Microcontroller with interfacir 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS:

1. Determination of transfer functions of DC servomotor.
2. Frequency response of Small-motion, linear zed model of industrial robot (second order) system using MATLAB.
3. Characteristics of PID controllers using MATLAB.
4. Stepper motor / Servo motor control using PLC.
5. Forward and Inverse kinematics to control hand movements in NAO ROBOT.
6. Study and selection of Gripper.
7. Implementation of trajectory planning algorithm for straight line motion using Matlab.
8. Analysis of blinds guiding robot.
9. Analysis of rescue robot.
10. Familiarization of six Degree of Freedom (DOF) industrial robot.
11. Teaching different positions and doing ‘pick & place’ task of robot.
12. Solving and verifying forward kinematics problem.

P18PCCD2L2	ADVANCED COMPUTER AIDED MODELLING,ANALYSIS AND OPTIMIZATION LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Basic CAD lab				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the designing and evaluating the automobile engine components such as Piston, Connecting rod, Crankshaft, Journal bearings, Camshaft and Automobile chassis components such as Vehicle Chassis, Leaf Spring and Rear axle systems with calculation and model analysis.

COURSE OUTCOMES (COs)

CO1	To Know and to study the Design and Analysis part of Automobile Components
CO2	To Design and to analyze the Engine components with design calculation and Model Analysis
CO3	To Design and to analyze the Chassis components with design calculation and Model Analysis
CO4	To Design and Analyze the Front and Rear axle systems
CO5	To Design and Analyze the various types of gearboxes

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

1) Design and Typical tasks of Modeling using CREO, CATIA solid modeling packages
   Surface modeling
   Solid Modeling
   Drafting and Assembly

2) Solving simple stress analysis problems using FEM

3) FE Analysis using Ansys Package for different structures and machine elements that can be descretized with 1-D, 2-D ,3 D elements to perform the following analysis:
   1. Static Analysis
   2. Modal Analysis
   3. Thermal Analysis
   4. Transient analysis

4) Identification of stress concentrations zones, carrying design modification so as to minimize the stress concentrations and for optimization.
5) Remodelling and FE stress Analysis

6) Draw the shear force and bending moment diagrams for cantilever beam using ansys tool and to remodel them for optimization.

P18PRCD2P1	**MINI PROJECT WITH SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES

- The purpose of technical seminar is to train the students in preparing and presenting Technical topics.
- The students are expected to give a presentation on their topics of interest which will be Assessed by a Faculty in charge, for this purpose during the current semester as per the Academic regulations.
- The student shall be capable of identify design, fabricate mini projects of power electronicComponents

SEMESTER III

P18PRAU3P1	DISSERTATIONPHASE I	L	T	P	C
	Total Contact Hours: 45	0	0	20	16
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowledge sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Core (PC)				
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

SEMESTER-IV

P18PRAU4P2	PHASE II DISSERTATION	L	T	P	C
	Total Contact Hours: 45	0	0	32	16
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowlec sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

LIST OF ELECTIVES

PROGRAMME ELECTIVE – I

P18PECD01	ENGINEERING DESIGN	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Design of Machine Elements				
	Course Designed by :Department of Mechanical Engineering				

OBJECTIVES

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

COURSE OUTCOMES (COs)

CO1	Students will realize that creativity, manufacturability, assembly, maintainability,etc
CO2	Students will demonstrate the ability to identify needs of the customer and convert them to technical specifications of a product
CO3	Students will be able to generate different ideas after identifying the need and determini the specifications and constraints of a product for a particular purpose
CO4	Students will understand the principals used while designing for manufacture, assembly emotions and maintenance
CO5	Students will know various methods of rapid prototyping the products to test and modify the designs. Students will be able to design the components considering strength based reliability

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Unit 1: Development processes and organizations, Material selection and Product Planning

Unit 2: Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing .Frequency distribution. Measure of central tendancy and dispersion and analysis of variance

Unit 3: Design for manufacture, assembly, maintenance, casting, forging,

Unit 4: Design for Reliability, strength based reliability, parallel and series systems, robust design, FMEA –fault tree analysis- defects and failure modes

Unit 5: costing in design –categories if costs –life cycle costing Industrial design: Design for Emotion and experience, Introduction to retrofit and Ecodesign, Human behavior in design. Introduction to rapid prototyping

REFERENCES:

Prashant Kumar, "Product Design, Creativity, Concepts and Usability", Eastern Economy Edition, PHI New Delhi. 12

George E Dieter, "Engineering Design", McGraw Hill Company..

Woodson T.T., "Introduction to Engineering Design", McGraw Hill Book Company, 1966.

John J.C. "Design Methods", Wiley Inter science, 1970.

Averill M. Law and W. David Kelton "Simulation, modelling and analysis", McGraw Hill Book Company, 1991.

Pahl, G.and W.Beitz, *Engineering Design–A Systematic Approach* – Springer, 2nd Ed., 1996.

Product Design and development Karl T. Ulrich, Steven Eppinger

.

P18 PEMD01	DESIGN CONCEPTS FOR MANIFACTURING AND ASSEMBLY	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Basic Electrical and Electronics, Automotive Electrical systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

COURSE OUTCOMES (COs)

CO1	Understand the product development cycle
CO2	Know the manufacturing issues that must be considered in the mechanical engineering design process
CO3	Know the principles of assembly to minimize the assembly time
CO4	Know the effect of manufacturing process and assembly operations on the cost of product (not included by others)
CO5	Be familiar with tools and methods to facilitate development of manufactural mechanical designs

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

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:

M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 03.

G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 00.

M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999.

T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY, 00.

K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.

S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.

G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.

J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.

Houldcroft, Which Process – an introduction to welding and related processes and guide to their selection, Cambridge, Abington Pub., 1990.

ASTM Design handbook.

P18PECD011	ADVANCED MATHEMATICS FOR CAD ENGINEERS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Engineering Mathematics-I, II & III, Numerical methods				
	Course Designed by :Department of Mathematics				

OBJECTIVES

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

COURSE OUTCOMES (COs)

CO1	To learn and Compute eigen values and eigen vectors by different methods.
CO2	To Solve different non-linear ordinary and Partial differential equations
CO3	To Solve Problems of variation applicable in Automobile engineering.
CO4	To Find numerical solution for advanced problems in interpolation and integration
CO5	To Solve LPP by different algorithms.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I PROBABILITY THEORY& RANDOM VARIABLE

Probability Theory and Sampling Distributions, Basic probability theory along with examples, Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential, Central Limit Theorem and its significance, Some sampling distributions like 2, t, F.

UNIT II TESTING OF HYPOTHESIS

Testing a statistical hypothesis, tests on single sample and two samples concerning means and Variances, ANOVA: One – way, two – way with/without interactions. Fundamentals of MATLAB and PYTHON

UNIT III DIFFERENTIAL EQUATIONS

Ordinary linear differential equations solvable by direct solution methods; solvable non-linearOrdinary Differential Equations.

First and Second order partial differential equations; canonical forms; Solution methods for wave equation, D'Alembert's solution, potential equation, properties of Harmonic functions, maximum principle, solution by variable separation method.

UNIT IV ADVANCED MATRIX THEORY

Eigen values using QR transformations – generalized eigen vectors – canonical forms – singular value decomposition and applications –pseudo inverse – least square approximations. Determinants.

UNIT-V:CALCULUS OF VARIATIONS9Hrs

Euler's equation – Variational problems in parametric form – Natural Boundary condition – Conditional Extremum – Isoperimetric problems- Direct methods in Variational problems – Euler's finite difference method – Rayleigh – Ritz Method – Galerkin's method.

REFERENCE BOOKS

1. Douglas C. Montgomery, Design and Analysis of Experiments (7th Edition), Wiley Student Edition, 09.
2. S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition, 08
3. William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and
4. Statistics for Engineering, (4th Edition), Willey Student edition, 06.
5. Advanced Engineering Mathematics (9th Edition), Erwin Kreyszig, Wiley India (13)
6. Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8th Edition), Pearson Prentice Hall, 07 (for Units I & II)
7. J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi, 10

PROGRAMME ELECTIVE – II

P18 PECD021	ADVANCED INTEGRATED PRODUCTION DESIGN & DEVELOPMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Control of vehicles Systems, Engine and Vehicle Management Systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in safety and comfort systems in automotive vehicles. It also clearly describes the basic ergonomic need in developing various vehicle applications through inputing bio thermal and bio mechanical systems.

COURSE OUTCOMES (COs)

CO1	To Know and to study about Biomechanics And Bio Thermalsystems
CO2	To Study about the basics of various safety aspects and comfort systems in vehicle
CO3	To learn about Vehicle Ergonomics
CO4	To learn about the utilization of human factors and applications in automotive field
CO5	To study on advance safety systems and ergonomic factors

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

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.

Total Periods: 45

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.

P18 PEMD041	**Multi-body Dynamics**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Refrigeration and Air-conditioning, Thermodynamics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on studying the various methods of processes involved inAutomotive Air-Conditioning Systems. The students can able to understand the concepts involved in various cycles of refrigeration and heating.

COURSE OUTCOMES (COs)

CO1	Derive equations of motion for interconnected bodies in multi-body systems with three-dimensional motion.
CO2	Implement and analyze methods of formulating equations of motion forinterconnected bodies.
CO3	Write programs to solve constrained differential equations for analyzing multi-body systems
CO4	Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis

CO5		Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems. Demonstrate an improved technical writing and presentation skills				
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1. Introduction:

The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairsare considered together with other 2 degrees-of-freedom types of constraints.

Unit 2. Basic principles for analysis of mulyi-body systems:

The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations.

Unit 3. Dynamics of Planar Systems:

Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial-value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

Unit 4. Kinematics of rigid bodies

Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

Unit 5. Computation of Forces:

Computation of spatial generalized forces for external forces and for actuator-spring-damper element. Computation of reaction forces from Lagrange's multi- pliers

REFERENCES:

Wittenburg, J., *Dynamics of Systems of Rigid Bodies*, B.G. Teubner, Stuttgart, 1977.

Kane, T.R, Levinson, D.A., *Dynamics: Theory and Applications*, McGraw-Hill Book Co., 1985.

Nikravesh, P.E., *Computer Aided Analysis of Mechanical Systems*, Prentice-Hall Inc., Englewood Cliffs, NJ, 1988.

Roberson, R.E., Schwertassek, R., *Dynamics of Multibody Systems*, Springer-Verlag, Berlin, 1988.

Haug, E.J., *Computer-Aided Kinematics and Dynamics of Mechanical Systems-BasicMethods*, Allyn and Bacon, 1989.

Huston, R.L., *Multibody Dynamics*, Butterworth-Heinemann, 1990.

Schielen, W. *ed.*, *Multibody Systems Handbook*, Springer-Verlag, Berlin, 1990.

de Jalon, J.C., Bayo, E., *Kinematic and Dynamic Simulation of Multibody Systems*, Springer-Verlag, 1994.

P18PECD023	**ADVANCED MECHANICAL VIBRATIONS AND ACOUISTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Automobile Engineering, Vehicle Body Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

COURSE OUTCOMES (COs)

CO1	The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations. They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
CO2	The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the Eigen-values and mode shapes of natu vibrations and response to harmonic and arbitrary excitations
CO3	The students will be able to obtain the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes.

CO4	Student will be able to obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunckerley's method, and Stodola's method.
CO5	Student will know various terminologies used in acoustics and acoustic wave transmission, derive plane and spherical wave equations, and obtain sound pressure level at a given distance from a simple sound source of known strength. Students should understand the basics of psychoacoustics, equal loudness contours, dBA scale, loudness, pitch and timbre.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Transient Vibrations, Response of a single degree of freedom system to step and anyarbitrary excitation, convolution (Duhamel's) integral, impulse response function. Torsional vibration.

Unit 2: Multi degree of freedom systems, Free, damped and forced vibrations of two degree offreedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion,

Unit 3: Continuous Systems, Natural Vibrations of beams – Differential equation of motion,solution by the method of separation of variables, frequency parameter, natural frequencies and mode shapes, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method, discretized models of continuous systems and their solutions using Rayleigh – Ritz method .critical speeds.

Unit 4: Vibration Control, Methods of vibration control, principle of superposition, Numerical
and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's methods, matrix iteration method for Eigen-value calculations, Holzer's method,

Unit 5

Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source.Psychoacoustics, Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise.

REFERENCES:

Thomson W.T., "Theory of Vibrations with applications", George Allen and Unwh Ltd. London, 1981.

S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.

Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition.

S. Timoshenko, "Vibration problems in Engineering", Wiley, 1974.

Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.

Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II. , Chemical Publishing Co., New York, 1977.

PROGRAM ELECTIVE – III

P18PECD031	TRIBOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC Engines and Emissions, Automotive Engines and Combustion Characteristics,				
	Course Designed by- Department of Mechanical 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.

Course Outcomes

CO1 The students will be able to apply theories of friction and wear to various practical situations by analysing the physics of the process.

CO2 - They will understand the various surface measurement techniques and effect of surface texture on Tribological behavior of a surface

CO3 - They will be able to select materials and lubricants to suggest a tribological solution to a particular situation.

CO4 – The students will be able to design a hydrodynamic bearing using various bearing charts

CO5 - The students will be able to understand the recent developments in the field and understand modern research material

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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	H	H	H	H	M	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	H		L	M		H	L	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 (H)
						√			

4	Approval	47th Meeting of Academic Council-Aug, 2018

SYLLABUS CONTENT:

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

P18 PECD032	**ROBOTICS AND CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: CAD/CAM, Computer Integrated Manufacturing, Compute aided process planning and development				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge CAD procedures and acquire skills in designing and development of a product.

COURSE OUTCOMES (COs)

CO1	understand basic terminologies and concepts associated with Robotics and Automation demontrate comprehension of various Robotic sub-systems
CO2	understand kinematics and dynamics to explain exact working pattern of robots aware of the associated recent updates in Robotics
CO3	
CO4	
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
2	CO1	H	H	M	H	M

	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1 Introduction:

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Unit 2 Robot Grippers, Drives and control system

Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems,

Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.

Unit 3 Kinematics:

Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain.

Dynamics:- Introduction to Dynamics , Trajectory generations

Unit 4 Machine Vision System:

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

Unit 5: Modeling and Simulation for manufacturing Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

Artificial Intelligence:- Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics

References:

John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04

Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.

Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co, 01.

Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.

Industrial Automation: W.P. David, John Wiley and Sons.

Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.

Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

P18 PECD033	Fundamentals of Fracture Mechanics	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive chassis, Automotive Aerodynamics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

COURSE OUTCOMES (COs)

CO1	Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral,Crack tip opening displacement.
CO2	Students will be able to manage singularity at crack tip using complex variable
CO3	Students will understand important role played by plastic zone at the crack tip
CO4	Students will learn modern fatigue and will able to calculate the fatigue life of a componer with or without crack in it
CO5	Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	H	H	M
	CO2	H	H	L	M	H
	CO3	H	M	H	M	L
	CO4	M	H	L	H	H
	CO5	H	M	L	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

SYLLABUS CONTENT:

Unit 1: Modes of fracture failure, Brittle and ductile fracture,

Unit 2: Energy release rate: crack resistance, stable and unstable crack growth.

Unit 3: Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks.

Unit 4: Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of platethickness, J-Integral. Crack tip opening displacement.

Test methods for determining critical energy release rate, critical stress intensity factor,J-Integral.

Unit 5: Fatigue failure: Crack propagation, effect of an overload, crack closure, variableamplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques.

References:

Brook D, "Elementary engineering fracture mechanics".

Liebowitz H., "Fracture" Volume I to VII.

A Nadai, W. S. Hemp, "Theory of flow and fracture of solids", McGraw Hill Book Company, 1950

P18 PECD041	**Optimization Techniques in Design**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive Engines and Emissions, IC engines and Alternative Fuels, Automotive Electronics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To explain the principle of engines electronic management system and different sensors used in the systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics with its description on various systems
CO2	To Know about the various functions of Sensors and Actuators present in the vehicle
CO3	To study about the SI Engine management systems with its techniques
CO4	To study about the CI Engine management systems with its techniques
CO5	To study about the Digital engine control systems with Vehicle management systems and their 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H

	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENTS:

Unit 1: Introduction to optimization, classification of optimisation problems, classical optimization techniques,

Unit 2: Linear programming, simplex method and Duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's methods,

Unit 3:Non-Linear Programming: - One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods,

Unit 4: Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts, etc.

Unit 5: Introduction to Genetic Algorithms, Operators, applications to engineering optimization problems.

REFERENCES:

S. S. Stricker, "Optimising performance of energy systems" Battelle Press, New York, 1985.

R.C. Johnson, "Optimum Design of Mechanical Elements", Willey, New York, 1980.

J. S. Arora, "Introduction to Optimum Design", McGraw Hill, New York, 1989.

Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India, New Delhi, 05

L.C.W. Dixon, "Non-Linear Optimisation - Theory and Algorithms", Birkhauser, Boston, 1980.

R.J. Duffin, E.L. Peterson and C.Zener "Geometric Programming-Theory and Applications", Willey, New York, 1967.

G.B. Dantzig "Linear Programming and Extensions Princeton University Press", Princeton, N. J., 1963.

R. Bellman "Dynamic Programming-Princeton" University Press, Princeton, N.J. 1957

P18 PECD 042	RAPID PROTOTYPING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nanotechnology, Mechanics of Materials and Automotive Chassis				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Know about the Noise, Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles.

COURSE OUTCOMES (COs)

CO1	To know and to study thebasics of vibration analysis
CO2	To know and to understand thevibration control techniques
CO3	To study about the basics of noise and its control methods
CO4	To study about the NVH measurements taken care in automotive systems
CO5	To study about the automotive noise sources and their 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

UNIT I –INTRODUCTION **9**

Basic concepts –Existing technologies and tools used in RPT – need for RPT- Effects of RPT on marketing.

UNIT II –PRODUCT DEVELOPMENT **9**

State of technology –Design concept – Development of concept – Detailed design – Prototype –Tooling – Engineering pilot – limitations.

UNIT III –CAD PROCESSES

Data requirements –Solid modelling –Data representation- part orientation and support-STL format-slicing –post processing **9**

UNIT IV - PROTOTYPING

Selective laser sintering –working principles-advantages and disadvantages-Stereo lithography- Working principle –Applications, Advantages and limitations- case studies.

UNIT V- RECENT METHODS

Laminated object modeling –waving principles –advantages and limitations – Fused deposition modelling –Direct shell production casting - Applications

REFERENCES:

1. Paul FJacobs , Rapid Prototyping and Manufacture fundamentals of Stereolithography,1995

,

2. Soenen.R and otting, Advnced CAD/CAM system, Narosa publishing House 1995.

P18PECD043	DESIGN OF PRESSURE VESSELS AND PIPING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Motor Vehicle Act and traffic Regulations				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on managing transport systems and to follow the rules and regulations of Motor Industry. Students might able to know the fundamentals and activities of transport systems

COURSE OUTCOMES (COs)

CO1	To know the basics of Transport systems on basis of types, elements and modes
CO2	To know and to understand the transport organization structure and its operations
CO3	To study about geographical conditions, economic factors and operations of transport organization
CO4	To study about the rules and regulations involved in Motor vehicle Act
CO5	To study about the laws and safety precautions developed in order to prevent accidents by 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT – I

INTRODUCTION PRESSURE VESSELS & STRESS PATTERNS **9**

Methods of determining stress – (1) strain gauges (2) photo elastic method (3) moiré fringe techniques terminology – ligament efficiency – applications.

UNIT – II

STRESSES IN PRESSURE VESSLES **9**

Introduction – Hoop, longitudinal & radial stresses – general theory of maintain stresses – thin & thick cylinders – shell components – cylindrical shells – vessel heads – thermal stresses – discontinuity stresses in pressure vessels. Shrink fit – auto fuettage – ultrahigh pressure vessel design. Bursting pressure.

UNIT – III

DESIGN OF VESSELS **9**

Design of Tall cylindrical self supporting process column – supports short vertical vessels – stress concentration – variable thickness transition section in cylindrical vessels. Circular hole – elliptical openings – theory of reinforced openings – Bolted & Welded joints – Design criteria & codes.

UNIT – IV

BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon – Elastic budding of circular ring and cylinders under external pressure – collapse of thick walled cylinders of tubes under external pressure – effect of supports on elastic buckling of cylinders – inelastic collapse – Bulking under combined external pressure and axial loading. Interaction method.

UNIT – V

PIPING **9**

Introduction – Flow diagram – piping layout and piping stress analysis

Total Periods: 45

References:

1. JOHN. F. HARVEY. 'Theory and Design of Pressure Vessels.' CBSD Distribution 1987.
2. HENRY. H. BENDER. "Pressure Vessel Design Hand Book CBSD Publication and distributors 1987.
3. WILLIAM J. BEES 'Approximate methods design and analysis of pressure vessels and piping'. Piping Conference 1997

PROGRAM ELECTIVE - V

P18PECD051	ADVANCED FINITE ELEMENT ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive chassis, Body Building Technology, Automotive Aerodynamics				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, paneling of passenger car body trim. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.

COURSE OUTCOMES (COs)

CO1	To Know and to visualize the Car body details with its design and construction
CO2	To Know and to visualize the Bus body details with its design and construction
CO3	To study about the vehicle design on basis to aerodynamic aspects and aesthetic features with safety concerns.
CO4	To Know and to visualize the Commercial vehicle details with its design and construction
CO5	To study about the procedures involved in designing Commercial vehicle pertaining to aerodynamic aspects

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	47th Meeting of Academic Council-Aug, 2018				

FE formulation of 1D bar, 3D linear elastic continuum, 2D plane strain, plane stress, and axisymmetric elements; Iso-parametric mapping; numerical integration.

Unit 2. FE formulation for 1D plasticity:

Elastic-perfectly plastic material; Isotropic and kinematic hardening; Integration algorithms for 1D plasticity; FE formulation; Newton-Raphson method for solving nonlinear equilibrium equations; 1D visco-plasticity and integration algorithm.

Unit 3. Continuum theories of plasticity:

Review of tensor algebra; Yield condition, flow rule and hardening rules; loading and unloading conditions; Drucker's stability postulates; Convexity and normality; J2 flow theory of plasticity and visco-plasticity, Gurson model.

Unit 4. FE procedures for 2D and 3D plasticity:

Integration algorithms for rate independent plasticity—explicit forward Euler and implicit backward Euler; Return mapping algorithm; visco-plasticity; FE formulation; Consistent linearization; Algorithmic and consistent tangent modulii; Treatment of incompressible deformation (Locking); B-bar method.

Unit 5. FE procedures for large deformation problems:

Continuum mechanics—deformation gradient, polar decomposition, Green-Lagrange strain, rate of deformation, Cauchy stress, P-K stresses, Balance laws; Principle of objectivity and isotropy; Constitutive equations for hyperelasticity; Neo-Hookean model; FE formulation—Total Lagrangian and updated Lagrangian descriptions; Tangent Stiffness Matrix. Introduction to finite strain plasticity. Condition of impenetrability; Gap elements for modelling contact; Tangent stiffness matrix and force vectors for 2D frictionless contact problems

REFERENCES

K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited, New Delhi, 1996

J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer-Verlag New York, Inc., New York, 1998

O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, Fifth Edition, Butterworth-Heinemann, Oxford.

P18PECD052	**Advanced Materials Science and Failure Analysis in Mechanical Design**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Vehicle Design, Vehicle Dynamics, Vehicle Body Building Technology				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

.

COURSE OUTCOMES (COs)

CO1	To Study the basis on Tyre classification and its properties
CO2	To Know the various process involved in the manufacturing of tyre and its fabric preparation
CO3	To Know the process of calendaring, skimming and bead formation with detailed description on process
CO4	To Study the process involved in thread extrusion and bead construction and to know tyre building techniques
CO5	To learn the basics involved in green tyre preparation and 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I. STRUCTURE, PROPERTIES AND APPLICATION OF ENGG. MATERIALS 9

Metals, Alloys, Ceramics & Glasses, Organic Polymers, Smart materials, Super alloys,
Shape memory alloys, Nano materials, Super hard cutting tool materials, Crystalline and Non crystalline state

Composite Materials.

UNIT II ELASTIC & PLASTIC DEFORMATION OF MATERIALS 9

Point imperfection, Dislocations, Surface imperfection, Stress-Strain curve, Dislocation motion analysis.

UNIT III. FAILURE ANALYSIS OF MATERIALS 9

Types of failure of materials, Creep, Fatigue, Fracture analysis. Mechanism of failure and Methods of protection against failure. Failure resistant materials.

UNIT IV DESIGN AGAINST STATIC LOAD 9

Factor of safety, Principal plane and principal stresses, Theories of failures, Stress concentration factors.

UNIT V DESIGN AGAINST FLUCTUATION LOAD 9

Endurance limits, S-N curve, Types of variable stresses, Soderberg equation, Goodman equation, Gerber equation.

BOOKS:

1. Failure of materials in Mechanical designby J.A.Collins, A Wiley - Interscience publication. copyright@1981 by John Wiley & Sons, Inc.
2. Material science and Engineering by V.Raghavan, 5th edition, 2012, published by Asoke K.Ghush, PHI Learning pvt. Ltd.
3. Design of Machine elements, 3rd edition by V.B.Bhandari, Tata.McGraw Hill education pvt. Ltd., New Delhi.
4. The Science and Engineering of materials, SI Edition, Donald R. Askeland, Pradeep P. Fulay, Wendelin J.

OPEN ELECTIVES

		L	T	P	C
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Business Administration				

OBJECTIVES

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.

- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends 4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

		L	T	P	C
P18OEMA003	**INDUSTRIAL SAFETY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES

1. To study about the industrial safety and types.
2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety 9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering 9 Hours

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.

Module III Wear and Corrosion and their prevention 9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing 9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance 9 Hours

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

References Books:

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.

		L	T	P	C
P18OEMA002	**OPERATIONS RESEARCH**				
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mathemathics				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.
To apply the concept of non-linear programming.
An ability to carry out the sensitivity analysis.
An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques 9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method 9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM 9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming 9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical AnalysisandSimulation of Game Theory 9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

5. Pannerselvam, Operations Research: Prentice Hall of India 2010

		L	T	P	C
P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**				
	Total Contact Hours – 35	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Business Administration				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours
Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II Project Cost Management 10 Hours
Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing 10 Hours
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management 6 Hours
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

		L	T	P	C
P18OEME005	**COMPOSITE MATERIALS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering				

Module I Introduction 9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements 9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites 9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites 9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength 9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

		L	T	P	C
P18OEEE006	**WASTE TO ENERGY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Mechanical Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT I& AUDIT II

P18ACEN001	AUDIT : ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS

Module I 4 Hours

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II 4 Hours

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module III 4 Hours

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV 4 Hours

Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V 4 Hours

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Module VI 4 Hours

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission. Suggested Studies

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
5.

	AUDIT: DISASTER MANAGEMENT	L	T	P	C
P18ACCE002	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able

- to Learn to demonstrate a critical understanding of key concepts in disasterrisk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and Programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

Module I Introduction 4 Hours

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Module II Repercussions of Disasters and Hazards 4 Hours

Economic Damage, Loss of Humanand Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module III Disaster Prone Areas in India 4 Hours

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module IV Disaster Preparedness and Management 4 Hours

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module V Risk Assessment 4 Hours

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module VI Disaster Mitigation 4 Hours

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	AUDIT : SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS

Module I **8 Hours**
Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module II **8 Hours**
Order, Introduction of roots, Technical information about Sanskrit Literature

Module III **8 Hours**
Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

- Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	AUDIT : VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS

Module I **4 Hours**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Valuejudgments.

Module II **6 Hours**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module III **6 Hours**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

Module IV **6 Hours**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

Suggested reading

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	AUDIT: CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS

Module I History of Making of the Indian Constitution **4 Hours**
History Drafting Committee, (Composition& Working)

Module II Philosophy of the Indian Constitution **4 Hours**
Preamble, Salient Features

Module III Contours of Constitutional Rights &Duties **4 Hours**
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.

ModuleIV Organs of Governance **4 Hours**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Module V Local Administration **4 Hours**
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

Module VI Election Commission **4 Hours**
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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:
Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making
- undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

SYLLABUS

Module I Introduction and Methodology **4 Hours**

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

Module II Thematic overview **2 Hours**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module III Evidence on the effectiveness of pedagogical **4 Hours**

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV Professional development **4 Hours**

Alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module V Research gaps and future directions **2 Hours**

Researchdesign,Contexts,PedagogyTeachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading:

a. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
b. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
c. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
d. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic bmaths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
e. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
f. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
g. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	**AUDIT : STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS

Module I **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

Module II: **8 Hours**

Yam and Niyam.Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module III **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

- Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also Improve efficiency

P18ACBA008	AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS

Module I **8 Hours**

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module II

Approach to day to day work and duties. **8 Hours**
ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module III **8 Hours**

Statements of basic knowledge.
ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. ShrimadBhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Suggested Reading

1. Srimad Bhagavad Gita, by Swami SwarupanandaAdvaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperityStudy of Neetishatakam will help in developing versatile personality of students.

CURRICULUM AND SYLLABUS

(R2018)

CHOICE BASED CREDIT SYSTEM

(Applicable to the batches admitted from July, 2018)

M.TECH – MACHINE DESIGN

I – IV SEMESTERS

SEMESTER–I							
S.No	**Category**	**Code**	**Course Name**	**L**	**T**	**P**	**C**
THEORY							
1	PC	P18PCMD101	Advanced Stress Analysis	3	0	0	3
2	PC	P18PCMD102	Advanced Vibrations and Acoustics	3	0	0	3
3	PE		Program Elective – I	3	0	0	3
4	PE		Program Elective – II	3	0	0	3
5	PR	P18PRMD103	Research Methodology and IPR	2	0	0	2
PRACTICAL							
6	PC	P18PCMD1L1	Mechanism, Machine Elements and Advanced Mechanical Design Lab	0	0	4	2
7	PC	P18PCMD1L2	Design practice using CAD tools	0	0	4	2
AUDIT COURSE							
8	Audit 1		Audit Course - 1	2	0	0	0
Total				**16**	**0**	**8**	**18**

SEMESTER–II

S.No	Category	Code	Course Name	L	T	P	C
THEORY							
1	PC	P18PCMD201	Finite Element Method	3	0	0	3
2	PC	P18PCMD202	Advanced Design of Transmission System	3	0	0	3
3	PE		Program Elective – III	3	0	0	3
4	PE		Program Elective – IV	3	0	0	3
PRACTICAL							
5	PC	P18PCMD2L1	Automation, Robotics & Control Lab	0	0	4	2
6	PC	P18PCMD2L2	Computer Aided Modelling , Analysis and Optimization Lab	0	0	4	2
7	PR	P18PRMD2P1	Mini Project with Seminar	0	0	4	2
AUDIT COURSE							
8	Audit 2		Audit Course – 2	2	0	0	0
			Total	**14**	**0**	**12**	**18**

SEMESTER–III

S.No	Category	Code	Course Name	L	T	P	C
1	PE		Program Elective - V	3	0	0	3
2	OE		Open Elective	3	0	0	3
3	PR	P18PRMD3P2	Dissertation Phase – I	0	0	20	10
Total				**6**	**0**	**20**	**16**

SEMESTER–IV

S.No	Category	Code	Course Name	L	T	P	C
1	PR	P18PRMD4P3	Dissertation Phase – II	0	0	32	16
Total				**0**	**0**	**32**	**16**

Total Credit for the programme =

18+18+16+16=68

LIST OF ELECTIVES

Programme Electives I (PE-I)

S.N	Code	Subject Name	L	T	P	C
1	P18PEMD011	Advanced Engineering Design	3	0	0	3
2	P18PEMD012	Design for Manufacturing and Assembly	3	0	0	3
3	P18PEMD013	Advanced Mathematical Methods for Mechanical Design Engineers	3	0	0	3

Programme Electives II (PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
1	P18PEMD021	Advanced Engineering Materials	3	0	0	3
2	P18PEMD022	Mechanics of Composite Materials	3	0	0	3
3	P18PEMD023	Analysis and Synthesis of Mechanism	3	0	0	3

Programme Electives III (PE-III)

1	P18PEMD031	Tribology in Design	3	0	0	3
2	P18PEMD032	Robotics	3	0	0	3
3	P18PEMD033	Fracture Mechanics	3	0	0	3
4	P18PEMD034	Integrated Product Design & Development	3	0	0	3

Programme Electives IV (PE-IV)

1	P18PEMD041	Multibody Dynamics	3	0	0	3
2	P18PEMD042	Condition Based Monitoring	3	0	0	3
3	P18PEMD043	Machine Tool Design	3	0	0	3
4	P18PEMD044	Advanced Design of Pressure Vessel and Piping	3	0	0	3

Programme Electives V (PE-V)

1	P18PEMD051	Advanced Finite Element Method	3	0	0	3
2	P18PEMD052	Advanced Materials Science and Failure Analysis in Mechine Design	3	0	0	3

List of Open Elective (OE)

S.No	Code No.	Course Title	Contact	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

Audit course 1 & 2

S.No	Code No.	Course Title	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	3	0	0	0
2	P18ACCE002	Disaster Management	3	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	3	0	0	0
4	P18ACBA004	Value Addition	3	0	0	0
5	P18ACLW005	Constitution of India	3	0	0	0
6	P18ACBA006	Pedagogy Studies	3	0	0	0
7	P18ACYO007	Stress Management by Yoga	3	0	0	0
8	P18ACBA008	Personality Development through Life	3	0	0	0

P18PCMD101	ADVANCED STRESS ANALYSIS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Mechanics of solids				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

COURSE OUTCOMES (COs)

CO1	Students will understand the tonsorial approach of continuum mechanics and comprehend modern research material
CO2	Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship
CO3	Students will be able to apply basic field equations to torsion, bending and two dimension elasticity problems, and energy methods
CO4	Students will be able to solve problems in unsymmetrical bending and shear center, contac stresses and pressurized cylinders and rotating discs
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Theory of Elasticity

Analysis of stress, Analysis of stain, Elasticity problems in two dimension and three dimensions, Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates.

Unit 2. Energy Methods

Energy method for analysis of stress, strain and deflection **T**he three theorem's -theorem of virtual work, theorem of least work, Castiglioni's theorem, Rayleigh Ritz method, Galekin's method, Elastic behavior of anisotropic materials like fiber reinforced composites.

Unit 3. Theory of Torsion

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft.

Unit 4. Unsymmetrical Bending and Shear Centre

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section. .

Unit 5. Pressurized Cylinders ,Rotating Disks and contact stresses

Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc**.**

Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area. Introduction to Analysis of low speed impact

REFERENCES:

Sadd, Martin H., Elasticity: Theory, applications and Numeric, Academic Press 05 (Text Book)

Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 00

Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999

Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991

Theory of Elasticity – Timoshenko and Goodier, Mc Graw Hill

Advanced Strength of Materials, Vol. 1,2 – Timoshenko, CBS

Advanced Strength of Materials – Den Harteg

P18PCMD102	ADVANCED VIBRATIONS AND ACOUISTICS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Automobile Engineering, Vehicle Body Engineering				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Study of the Constructional details and Theory of important drive line, Structural,
- Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems are to be done.

COURSE OUTCOMES (COs)

CO1	The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations. They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
CO2	The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the Eigen-values and mode shapes of natu vibrations and response to harmonic and arbitrary excitations
CO3	The students will be able to obtain the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes.
CO4	Student will be able to obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunckerley's method, and Stodola's method.
CO5	Student will know various terminologies used in acoustics and acoustic wave transmission, derive plane and spherical wave equations, and obtain sound pressure level at a given distance from a simple sound source of known strength. Students should understand the basics of psychoacoustics, equal loudness contours, dBA scale, loudness, pitch and timbre.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function

Unit 2: Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion,

Unit 3: Continuous Systems, Natural Vibrations of beams – Differential equation of motion, solution by the method of separation of variables, frequency parameter, natural frequencies and mode shapes, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method, discretized models of continuous systems and their solutions using Rayleigh – Ritz method

Unit 4: Vibration Control, Methods of vibration control, principle of superposition, Numerical
and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's methods, matrix iteration method for Eigen-value calculations, Holzer's method,

Unit 5

Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source.Psychoacoustics, Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise.

REFERENCES:

Thomson W.T., "Theory of Vibrations with applications", George Allen and Unwh Ltd. London, 1981.

S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.

Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition.

S. Timoshenko, "Vibration problems in Engineering", Wiley, 1974.

Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.

Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II. , Chemical Publishing Co., New York, 1977.

P18PRMD103	RESEARCH METHODLOGY AND IPR	L	T	P	C
	Total Contact Hours: 60	2	0	0	2
	Prerequisite:				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

- Understanding that when IPR would take such important place in growth of individuals &

Nation, it is needless to emphasis the need of information about Intellectual Property Right

to be promoted among students in general & engineering in particular.

- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

COURSE OUTCOMES (COs)

CO1	Understand research Poblem Formulation. Analyze research related informati Follow research ethics
CO2	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO3	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular
CO4	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis

Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper

1.
2. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
3.
4. **Unit 4:** Nature of Intellectual Property: Patents, Designs, Trade and Copyright.
5. Process of
6. Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
7.
8. **Unit 5:** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
9.
10. **:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
11.
12. **REFERENCES:**
13.
14. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for
15. science & engineering students'"
16. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
17.
18. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for
19. beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

20. Mayall , “Industrial Design”, McGraw Hill,
1992. Niebel , “Product Design”, McGraw
21. Hill, 1974.
22. Asimov , “Introduction to Design”, Prentice Hall, 1962.
23.
24. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
25. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

P18PCMD1L1	MECHANISM,MACHINE ELEMENTS AND ADVANCED MECHANICAL DESIGN LAB	L	T	P	C
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Automotive Engines and Emissions, Alternate Fuels, IC Engines				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the assembling and dismantling and study of different types of an engine and its various systems like steering system, transmission system, electrical system, ignition system, injection system, Braking system. At the end of the course the student will be well versed in the assembling and dismantling of any vehicles with performance study of SI and CI engines.

COURSE OUTCOMES (COs)

CO1	To Know and to study the performance aspects of SI and CI engines
CO2	To Study and to determine the Pressure crank angle
CO3	To learn about CMC & PMC Characteristics with its type in detail
CO4	To learn about Heat Balance Test on IC engines
CO5	To study on Assembling and Dismantling of various SI and CI 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS

1. Kinematics analysis of Four Bar mechanism.
2. Kinematics analysis of Slider Crank,
3. Analysis of quick return mechanism.
4. Vibration measurement using electro dynamic pickup.
5. Vibration measurement using oscilloscope
6. Determination natural frequency using dunkerleys rules and experimental verification.
7. Dynamic analysis of cantilever beam using **C** programming / MAT lab
8. Determination of natural frequency of a solid shaft using computer programming / MAT lab
9. Determination of natural frequency of simple machine elements using theoretical and experimental and simulation techniques.
10. Determination of critical speed of rotating shaft
11. Design of machine elements using MAT lab and C programming.
12. Design of structural components using MAT lab software / computer programming.

P18PCMD1L2	DESIGN PRACTICE USING CAD TOOLS	L	T	P	C
	Total Contact Hours - 45	0	0	4	2
	Prerequisite – Automotive Technology, Automotive Braking and Suspension Systems, Vehicle Body Engineering and Chassis Management systems				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE

Study of the Following Engines and Its Components by Dismantling, Comparing With Recent Engine Components and Assembling Various Parts

Course Outcomes

CO1 – Dismantling procedure of Clutch, Gear Box, Brake system

CO2 – Dismantling procedure of Differential Unit

CO3 – Study and Propeller Shaft Unit

CO4 – Assembling procedure of Clutch, Gear Box, Brake system, Differential 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
2	CO1	H	H	M		H	M	M	M	H	H	H	H
	CO2									M			
	CO3		H	H	M	H	H	H		H		M	H
	CO4	H					L		M		M		
	CO5			H		H		M		M		M	M
	CO6	L	M	M		M	L		L	M	M	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

LIST OF EXPERIMENTS

The lab course would expose the students to Design , Geometric modelling and assembly in a CAD environment using tools used in industry like CATIA / NX / PTC Creo / Solid Works / Inventor etc. Toward the end of this course students should be able to do design and model the various types of structural and machine elements

List of Experiments (Indicative)

1. 2D view sketches and solid models of shaft support, machine block, sliding block & support, bearing bracket, vice-body, depth stop & flange connector and other machine elements [Design tree, visualisation tools, command and GUI managers, units etc.; Sketcher tools – profiles, dimensional & geometric constraints, transformation tools, coordinate systems etc.]
2. Design and Solid modelling and assembly of shafts , sleeve coupling , flange coupling and Universal coupling etc – use design tables/macros [Solid modeling –Sketch based features like extrude, revolve, sweep, etc and variational sweep, loft, etc., dress based features like fillet, chamfer, draft, shell etc. Boolean operations etc. design table macros, formulas and other design automation tools, mass property calculations, multibody features, functional

modelling etc. Assembly modelling : Assembly planning - Insert, position and orientation, assembly mating and simulation, interference and assembly analysis, assembly properties like CG etc., assembly approaches

3. Solid modelling, assembly and drafting with GD&T of a tool post Drafting – standard views, dimensioning, layouts, GD&T, Bill of materials, exploded views etc]

4. Solid modelling, assembly of a windmill and a study of assembly interference

5. Surface modelling of car body etc

6 Creation of surfaces from reverse engineered data from a toy car

7. Preparation of a CAD model of an aerofoil for FEA/CFD analysis For the above exercises make a professional CAD documentation for professional product presentations.

8. Other Design , 3D modeling and assembly diagrams of piston, connecting rod assembly etc.

P18PCMD201	FINITE ELEMENT METHOD	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Mechanical Engineering, Engineering Design, Machine and Component Drawing				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge vehicle frame and suspension, front axle and steering systems, clutch, gear box, drive line and rear axle will be taught to the students.

Course Outcomes

CO1 - Understand the concept of finite element method for solving machine design problems.

CO2 - Formulate and solve manually problems in 1-D structural systems involving bars, trusses, beams and frames

CO3 - Develop 2-D FE formulations involving triangular, quadrilateral elements and higher order elements

CO4 – Apply the knowledge of FEM for stress analysis, model analysis, heat transfer analysis and flow analysis

CO5 – Develop algorithms and write FE code for solving simple design problems and understand the use of commercial packages for complex 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	M	H		H	M	M	H	H	H	H	M
	CO2		M				H		L	H			M
	CO3		H		H	H		H		H		M	H
	CO4	H				M	H		H		H		
	CO5			M		H		M	M	H		M	H
	CO6	L	M	M		L	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 (H)
					√				
4	Approval	47th Meeting of Academic Council-Aug, 2018							

1. **SYLLABUS CONTENT:**
2.
3. **UNIT -1**
4. **BASIC CONCEPTS** **9**
5.

6. Field problems – elementary treatments – Elements & types – Mathematical modeling – Steady state problems – Progagation problems – Eigen value problems – Differential formulation – Variational methods – weighted residual methods – Convergence criteria – Error estimation.

7. UNIT – II

8. PROCEDURES & INTERPOLATIONS **9**

9. Bar element - Mechanical & Thermal loads – Steps – Discretization – Element formulation – Connectivity – Global equation – Boundary conditions – Essential & natural b.c. – solution – Post processing – Shape functions – Lagrange interpolation – Temperature & strain distributors – Heat transfer.

10. UNIT III

11. ELASTICITY PROBLEMS **9**

12. Elasticity concepts – plane stress & strain – Element stiffness matrix – Strain – Displacement relations – Material property matrix – Constitutive relation ship – Nodal forces using equilibrium – Euler – Bernouli beam elements – Trusses & Frames.

13. UNIT IV

14. ISOPARAMETRIC FORMULATION **9**

15. Node numbering – Transformations – Natural Co-ordinates – Approximation of geometry – Isoparametric formulation – Gauss quadrature – Choice of quadrature rule – Stress calculation – Gauss point.

16. UNIT V

17.* THREE DIMENSIONAL PROBLEMS** ***9

18. 3-D problems & analysis – Applications – Computerized FEA – Preprocessing Mesh generation – Element types – Solution – Post processing – Case studies .

19. ***Total Periods: 45***

References:

1. J.N. Reddy – An introduction to finite Element methods – Mc Graw Hill 1993.
2. K.J. Bathe – Finite Element procedure – Prentice Hall of India 1997
3. O.C. Zienkiewicz – The Finite Element Methods – Me Graw Hill 1989.
4. T.R. Chandraputta A. D. Belegundu – introduction to Finite Elements in Engineering Prentice Hall of India . 1997

.

P18PCMD202	ADVANCED DESIGN OF TRASMISSION SYSTEM	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Automobile Engineering, Machine Design, Automotive Chassis				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

COURSE OUTCOMES (COs)

CO1	Understand the necessity of profile correction of gears

CO2	Design spur gears for any practical applications
CO3	Design Helical gears for any practical applications.
CO4	Design Bevel gears for any practical applications.
CO5	Design gear box for any 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT – I

Profile correction of gears – Types of corrected gearing – Design of internal spur gears and external spur gears – Design of Epicyclic gears.

UNIT – II

Helical gear terminology and relation – Equivalent spur gear – Profile correction – Contact ratio – Design of Crossed Helical gears – Design of herringbone gears.

UNIT – III

Profile bevel gears – correction – Spiral bevel gear – geometry and basic relations – Different systems – Forces on shaft carrying spiral , bevel gear – Design procedure for spirals bevel gears.

UNIV IV

Design of different types of gear boxes for Automobiles

UNIT – V

Design of Spur helical, bevel and worm gear speed reducers – Design of Bearing and shafts – Layout of the reducer.

References:

1. T.J. Prabhu , Design of transmission Elements 2002
2. Handbook of gear design – Maitra TMH , 1994.
3. PSG Design Data Book 2003

P18PCMD2L1	**AUTOMATION, ROBOTICS &CONTROL LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Basic Electrical and Electronics, Automotive Electrical and Electronics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To provide hands on training on automotive electrical and electronic systems and to provide knowledge on interfacing of different sensors and actuators used in the automobile systems.

COURSE OUTCOMES (COs)

CO1	To Know the basics of Automotive Electronics
CO2	To Know about the Electrical and Electronics Systems with their Characteristics
CO3	To study and to visualize the characteristics of Load cells, thermocouple and Strain gauges
CO4	To study about the Thermometers and Transducers
CO5	To study on the basic programming of Microprocessor and Microcontroller with interfacing 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

LIST OF EXPERIMENTS:

1. Determination of transfer functions of DC servomotor.
2. Frequency response of Small-motion, linear zed model of industrial robot (second order) system using MATLAB.
3. Characteristics of PID controllers using MATLAB.
4. Stepper motor / Servo motor control using PLC.
5. Forward and Inverse kinematics to control hand movements in NAO ROBOT.
6. Study and selection of Gripper.
7. Implementation of trajectory planning algorithm for straight line motion using Matlab.
8. Analysis of blinds guiding robot.
9. Analysis of rescue robot.
10. Familiarization of six Degree of Freedom (DOF) industrial robot.
11. Teaching different positions and doing 'pick & place' task of robot.
12. Solving and verifying forward kinematics problem.

P18PCMD2L2	**COMPUTER AIDED MODELLING, ANALYSIS AND OPTIMIZATION LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Vehicle Design, Design of Machine Components				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in the designing and evaluating the automobile engine components such as Piston, Connecting rod, Crankshaft, Journal bearings, Camshaft and Automobile chassis components such as Vehicle Chassis, Leaf Spring and Rear axle systems with calculation and model analysis.

COURSE OUTCOMES (COs)

CO1	To Know and to study the Design and Analysis part of Automobile Components
CO2	To Design and to analyze the Engine components with design calculation and Model Analysis
CO3	To Design and to analyze the Chassis components with design calculation and Model Analysis
CO4	To Design and Analyze the Front and Rear axle systems
CO5	To Design and Analyze the various types of gearboxes

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

1) Design and Typical tasks of Modeling using CREO, CATIA solid modeling packages
   Surface modeling
   Solid Modeling
   Drafting and Assembly

2) Solving simple stress analysis problems using FEM

3) FE Analysis using Ansys Package for different structures and machine elements that can be descretized with 1-D, 2-D ,3 D elements to perform the following analysis:
   1. Static Analysis
   2. Modal Analysis
   3. Thermal Analysis
   4. Transient analysis

4) Identification of stress concentrations zones, carrying design modification so as to minimize the stress concentrations and for optimization.
5) Remodelling and FE stress Analysis

6) Draw the shear force and bending moment diagrams for cantilever beam using ansys tool and to remodel them for optimization.

P18PRMD2P1	MINI PROJECT WITH SEMINAR	L	T	P	C
	Total Contact Hours – 45	0	0	4	2
	Prerequisite – NIL				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

- The purpose of technical seminar is to train the students in preparing and presenting Technical topics.
- The students are expected to give a presentation on their topics of interest which will be Assessed by a Faculty in charge, for this purpose during the current semester as per the Academic regulations.
- The student shall be capable of identify design, fabricate mini projects of power electronic Components

P18PRMD4P3	DISSERTATION PHASE I	L	T	P	C
	Total Contact Hours: 45	6	0	20	16
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowledge sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H

	CO5	H	M	L	M	L
3	Category	Professional Core (PC)				
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

P18PRMD4P3	**DISSERTATION PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	0	0	32	16
	Prerequisite: Technical Seminar, Project Review and Report generation				
	Course Designed by : Department of MechanicalEngineering				

OBJECTIVES

The objective of project work is to enable the student, a project involving some design and analysis work or theoretical and experimental studies related to the respective engineering discipline.

COURSE OUTCOMES (COs)

CO1	To Know and to State the area of the project irrespective of all classifications
CO2	To Study and to utilize the best method on basis of Cost, Material and Work Feasibility criteria
CO3	To understand and to rejenuvate the skills of thinking, leadership team effort and Knowlec sharing
CO4	To involve and to gather literature reviews on research activities with the aid of modern technological developments
CO5	To Create and to analyze the Model with Classified design with Fabricated Material Properties

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

1	COs/POs	a	b	c	d	e

2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

The objective of project work is to enable the student, a project involving some design and analysis 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. Three 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.

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.

LIST OF ELECTIVES

PROGRAM ELECTIVE - I

P18PEMD01	ADVANCED ENGINEERING DESIGN	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Engineering Mathematics-I, II & III, Numerical methods				
	Course Designed by :Department of Mathematics				

OBJECTIVES

To train the students to apply advanced mathematical tools in modeling real time problems in Automobile and solve algebraically and numerically.

COURSE OUTCOMES (COs)

CO1	Students will realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centered market.
CO2	Students will demonstrate the ability to identify needs of the customer and convert them to technical specifications of a product
CO3	Students will be able to generate different ideas after identifying the need and determini the specifications and constraints of a product for a particular purpose
CO4	Students will understand the principals used while designing for manufacture, assembly emotions and maintenance
CO5	Students will know various methods of rapid prototyping the products to test andmodify the designs. Students will be able to design the components considering strength based reliability

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	M	M
	CO2	H	H	M	H	M
	CO3	H	H	H	M	L
	CO4	H	H	H	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	47th Meeting of Academic Council-Aug, 2018

Unit 1: Development processes and organizations, Material selection and Product Planning

Unit 2: Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing .Frequency distribution. Measure of central tendancy and dispersion and analysis of variance

Unit 3: Design for manufacture, assembly, maintenance, casting, forging,

Unit 4: Design for Reliability, strength based reliability, parallel and series systems, robust design, FMEA –fault tree analysis- defects and failure modes

Unit 5: costing in design –categories if costs –life cycle costing Industrial design: Design for Emotion and experience, Introduction to retrofit and Eco design, Human behavior in design. Introduction to rapid prototyping

REFERENCES:

Prashant Kumar, "Product Design, Creativity, Concepts and Usability", Eastern Economy Edition, PHI New Delhi. 12

George E Dieter, "Engineering Design", McGraw Hill Company..

Woodson T.T., "Introduction to Engineering Design", McGraw Hill Book Company, 1966.

John J.C. "Design Methods", Wiley Inter science, 1970.

Averill M. Law and W. David Kelton "Simulation, modelling and analysis", McGraw Hill Book Company, 1991.

Pahl, G.and W.Beitz, *Engineering Design–A Systematic Approach* – Springer, 2nd Ed., 1996.

Product Design and development Karl T. Ulrich, Steven Eppinger

P18 PEMD01	**DESIGN FOR MANIFACTURING AND ASSEMBLY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Electrical and Electronics, Automotive Electrical systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, charging System, Ignition System, Lighting System and Dash – Board Instruments, Electronic ignition system, various sensors and the role of ECU.

COURSE OUTCOMES (COs)

CO1	Understand the product development cycle
CO2	Know the manufacturing issues that must be considered in the mechanical engineering design process

CO3	Know the principles of assembly to minimize the assembly time
CO4	Know the effect of manufacturing process and assembly operations on the cost of product (not included by others)
CO5	Be familiar with tools and methods to facilitate development of manufactural mechanical designs

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1: Introduction Need Identification and Problem Definition, Concept Generation and Evaluation, 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 for Casting, 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 for Welding – 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:

M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 03.

G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 00.

M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999.

T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY, 00.

K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.

S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.

G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.

J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.

Houldcroft, Which Process – an introduction to welding and related processes and guide to their selection, Cambridge, Abington Pub., 1990.

ASTM Design handbook.

P18 PEMD01	**ADVANCED MATHEAMATICAL METHODS FOR MECHANICAL DESIGN ENGINEERS.**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC engines, Automotive Pollution and Control, Environment and Ecosystems				
	Course Designed by- Department of Mechanical Engineering				

OBJECTIVE:

The main objective of this course is to impart knowledge in introduction, combustion of fuels, combustion modelling, non-conventional ic engines, combustion analysis in ic engines will be taught to the students.

Course Outcomes

CO01 - Explain the basic concepts of Probability and apply statistical techniques to analyze multivariate functions

CO02 - To understand the concepts in Large and Small samples and the analysis of variances

CO03 To identify and solve engineering problems by applying the knowledge of ordinary differential equations

CO04 – Identify and solve engineering problems by applying the knowledge partial differential equations

CO05 - To solve differential equations for stationary paths, subject to boundary conditions, in straightforward cases

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I PROBABILITY THEORY& RANDOM VARIABLE 9Hrs

Probability Theory and Sampling Distributions, Basic probability theory along with examples, Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential, Central Limit Theorem and its significance, Some sampling distributions like 2, t, F.

UNIT II TESTING OF HYPOTHESIS 9Hrs

Testing a statistical hypothesis, tests on single sample and two samples concerning means and
Variances, ANOVA: One – way, two – way with/without interactions.

UNIT III ORDINARY DIFFERENTIAL EQUATIONS 9Hrs

Ordinary linear differential equations solvable by direct solution methods; solvable non-linear Ordinary Differential Equations.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS 9Hrs

First and Second order partial differential equations; canonical forms; Solution methods for wave equation, D'Alembert's solution, potential equation, properties of Harmonic functions, maximum principle, solution by variable separation method.

UNIT-V:CALCULUS OF VARIATIONS 9Hrs

Euler's equation – Variational problems in parametric form – Natural Boundary condition – Conditional Extremum – Isoperimetric problems- Direct methods in Variational problems – Euler's finite difference method – Rayleigh – Ritz Method – Galerkin's method.

REFERENCE BOOKS

1. Douglas C. Montgomery, Design and Analysis of Experiments (7th Edition), Wiley Student Edition, 09.
2. S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition, 08
3. William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and
4. Statistics for Engineering, (4th Edition), Willey Student edition, 06.
5. Advanced Engineering Mathematics (9th Edition), Erwin Kreyszig, Wiley India (13)
6. Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8th Edition), Pearson Prentice Hall, 07 (for Units I & II)

7. J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi, 10
(for Units III & IV).

PROGRAMME ELECTIVES -II

P18 PEMD021	ADVANCED ENGINEERING MATERIALS	L	T	P	C
	Total Contact Hours: 60	3	0	0	3
	Prerequisite: Nano Technology and its applications, Production Technology , Metallurgy and Manufacturing Process				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in material science with modes of manufacturing process involved in construction of various technologies employed in automobile Industries. Students been focused on basics related to Nano technological developments which sustainably develop their skill in selection of materials for the process of manufacturing.

COURSE OUTCOMES (COs)

CO1	Demonstarte an understanding of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites
CO2	Understand existence of imperfections and their effects on mechanical properties of materials and cause of failure
CO3	Demonstrate understanding of phase diagrams and their use in predicting phase transformation and microstructure
CO4	Understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact
CO5	Know Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composites Understand the economic considerations in usage and recycling 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)

			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1. Introduction, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids:

Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern materials, Atomicstructure. Atomic bonding in solids, Crystal structures, Crystalline and noncrystalline materials. Miller indices. Anisotropic elasticity. Elastic behaviour of composites. Structure and properties of polymers. Structure and properties of ceramics.

Unit 2: Imperfections in Solids and Mechanical Properties of Metals, Diffusion, Dislocations and Strengthening Mechanisms:

Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or

volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Interpretation of tensile stress-strain curves Yielding under multiaxial stress. Yield criteria and macroscopic aspects of plastic deformation. Property variability and design factors, Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. Mechanisms of strengthening in metals. Recovery, recrystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles. Lattice

resistance to dislocation motion.

Unit3:Phase Diagrams

Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system

Unit4: Failure:

Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile brittle

transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep. Generalized creep behaviour. Stress and temperature effects

Unit 5: Applications and Processing of Metals and Alloys, Polymers, Ceramics, and composites:

Types of metals and alloys. Fabrication of metals. Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics, Mechanicalbehaviour of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types. Polymer synthesis and processing, Particle reinforced composites. Fibre reinforced composites. Structural composites. Thermal properties of materials.

REFERENCES:

Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons, 07

Modern Physical Metallurgy and Material Engineering, Science, Process, application, Smallman R.E., Bishop R J, Butterworth Heinemann, Sixth Ed., 1999

P18 PEMD022	MECHANICS OF COMPOSITE MATERIALS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Computer Control of vehicles Systems, Engine and Vehicle Management Systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The main objective of this course is to impart knowledge in safety and comfort systems in automotive vehicles. It also clearly describes the basic ergonomic need in developing various vehicle applications through inputing bio thermal and bio mechanical systems.

COURSE OUTCOMES (COs)

CO1	Student will be able to understand the basic concepts and difference between composite materials with conventional materials
CO2	Students will be able to understand role of constituent materials in defining the average properties and response of composite materials on macroscopi level.
CO3	Students will be able to apply knowledge for finding failure envelopes and stress-strain pl of laminates
CO4	
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1. Introduction

characteristics, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus

Unit 2.Basic Concepts and Characteristics

Structural performance of conventional material, Geometric and physical definition, Material response, Classification of composite materials, Scale of analysis; Micromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials

Unit 3.Elastic Behavior of Unidirectional Lamina

Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters

Unit 4.Strength of Unidirectional Lamina

Micromechanics of failure; failure mechanisms, Macro-mechanical strength parameters, Macro-mechanical failure theories, Applicability of various failure theories

Unit 5.Elastic Behavior ,stress and failure analysis of Laminate

Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates. Types of failures, Stress analysis and safety factors for first ply failure of symmetric laminates, Micromechanics of progressive failure; Progressive and ultimate laminate failure, Design methodology for structural composite materials

REFERENCES:

Isaac M. Daniels, Ori Ishai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 1994.

Bhagwan D. Agarwal, Lawrence J. Broutman, "Analysis and Performance of fiber composites", John Wiley and Sons, Inc. 1990.

Mathews, F. L. and Rawlings, R. D., "Composite Materials: Engineering and Science", CRC Press, Boca Raton, 03.

Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press, 04.

Mazumdar S. K., "Composaite Manufacturing – Materials, Product and Processing Engineering", CRC Press, Boca Raton, 02.

Robert M. Jones, "Mechanics of Composite Materials", Taylor and Francis, Inc., 1999

P18 PEMD023	ANALYSIS AND SYNTHESIS OF MECHANISM	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines. Automotive chassis, Automotive Electrical systems				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge of the vehicle

maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.	
COURSE OUTCOMES (COs)	
CO1	To develop analytical equations describing the relative position, velocity and acceleration of all moving links
CO2	To select, configure, and synthesize mechanical components into complete
CO3	Use kinematic geometry to formulate and solve constraint equations to design linkages specified tasks
CO4	Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
CO5	Analyze and animate the movement of planar and spherical four-bar linkages. students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems. Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical 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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1

Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.

Unit 2

Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.

Unit 3

Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms.

Unit 4

Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.

Unit 5

Coupler Curves : Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry. Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms

REFERENCES:

R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.

Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition

Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons New York

S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York

A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.

A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.

A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.

J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.

P18PEMD031	**TRIBOLOGY IN DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – IC Engines and Emissions, Automotive Engines and Combustion Characteristics,				
	Course Designed by- Department of Mechanical 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.

Course Outcomes

CO1 The students will be able to apply theories of friction and wear to various practical

situations by analysing the physics of the process.
CO2 - They will understand the various surface measurement techniques and effect of surface texture on Tribological behavior of a surface
CO3 - They will be able to select materials and lubricants to suggest a tribological solution to a particular situation.
CO4 – The students will be able to design a hydrodynamic bearing using various bearing charts
CO5 - The students will be able to understand the recent developments in the field and understand modern research material

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of 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	H	H	H	H	M	M
	CO2		M				H		L	H			M
	CO3		H		M	H		H		M		M	H
	CO4	H				M	M		H		H		
	CO5			M		H		H	M	H		M	H
	CO6	L	M	H		L	M		H	L	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 (H)
						√			
4	Approval	47th Meeting of Academic Council-Aug, 2018							

SYLLABUS CONTENT:

Unit 1: Friction, theories of friction, Friction control, Surface texture and measurement, genesis of 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 long plane 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 alternating loads, 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

P18 PEMD032	ROBOTICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: CAD/CAM, Computer Integrated Manufacturing, Compute aided process planning and development				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

At the end of the course, the students will be able to have a complete knowledge CAD procedures and acquire skills in designing and development of a product.

COURSE OUTCOMES (COs)

CO1	understand basic terminologies and concepts associated with Robotics and Automation demontrate comprehension of various Robotic sub-systems
CO2	understand kinematics and dynamics to explain exact working pattern of robots aware of the associated recent updates in Robotics
CO3	
CO4	
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1 Introduction:

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Unit 2 Robot Grippers, Drives and control system

Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems,

Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.

Unit 3 Kinematics:

Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain.

Dynamics:- Introduction to Dynamics , Trajectory generations

Unit 4 Machine Vision System:

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

Unit 5: Modeling and Simulation for manufacturing Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

Artificial Intelligence:- Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics

References:

John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04

Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.

Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co, 01.

Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.

Industrial Automation: W.P. David, John Wiley and Sons.

Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.

Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

PROGRAM ELECTIVE - II

P18 PEND033	Fracture Mechanics	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive chassis, Automotive Aerodynamics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

When the vehicle is at dynamic condition more vibration will be produced. It is essential to study about vibrations and how to reduce the vibration under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle. In this subject these aspects have been given.

COURSE OUTCOMES (COs)

CO1	Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral,Crack tip opening displacement.
CO2	Students will be able to manage singularity at crack tip using complex variable
CO3	Students will understand important role played by plastic zone at the crack tip
CO4	Students will learn modern fatigue and will able to calculate the fatigue life of a componer with or without crack in it
CO5	Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	H	H	M
	CO2	H	H	L	M	H
	CO3	H	M	H	M	L

	CO4	M	H	L	H	H
	CO5	H	M	L	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

SYLLABUS CONTENT:

Unit 1: Modes of fracture failure, Brittle and ductile fracture,
Unit 2: Energy release rate: crack resistance, stable and unstable crack growth.
Unit 3: Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks. **Unit 4:** Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement.
Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral.
Unit 5: Fatigue failure: Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques.

References:

Brook D, "Elementary engineering fracture mechanics".
Liebowitz H., "Fracture" Volume I to VII.
A Nadai, W. S. Hemp, "Theory of flow and fracture of solids", McGraw Hill Book Company, 1950

P18 PEMD034	**INTEGRATED PRODUCT DESIGN & DEVELOPMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Mechanical Engineering, Automotive Engines and sub systems				
	Course Designed by- Department of Mmechanical Engineering				
OBJECTIVE:					
The main objective of this course is to impart knowledge on various pollutants causing emissions in SI ad CI engine. It also helps to know about various test procedures to be carried out in determining SI and CI engine Emission with its control techniques.					
Course Outcomes					

CO1 - Gain knowledge on the various process of design and processes involved in product development
CO2 - Can do product analysis
CO3 - Can do different economics analysis
CO4- Can do platform planning
CO5- Can do break even 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
2	CO1	H	H	H	H	M
	CO2	H	H	L	M	H
	CO3	H	M	H	M	L
	CO4	M	H	L	H	H
	CO5	H	M	L	H	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

SYLLABUS CONTENT:

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.

Total Periods: 45

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.

PROGRAMME ELECTIVES- IV

P18 PEMD041	**Multi-body Dynamics**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Refrigeration and Air-conditioning, Thermodynamics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on studying the various methods of processes involved inAutomotive Air-Conditioning Systems. The students can able to understand the concepts involved in various cycles of refrigeration and heating.

COURSE OUTCOMES (COs)

CO1	Derive equations of motion for interconnected bodies in multi-body systems with three-dimensional motion.
CO2	Implement and analyze methods of formulating equations of motion forinterconnected bodies.
CO3	Write programs to solve constrained differential equations for analyzing multi-body systems
CO4	Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis
CO5	Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems. Demonstrate an improved technical writing and presentation skills

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1. Introduction:

The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints.

Unit 2. Basic principles for analysis of mulyi-body systems:

The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations.

Unit 3. Dynamics of Planar Systems:

Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial-value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

Unit 4. Kinematics of rigid bodies

Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

Unit 5. Computation of Forces:

Computation of spatial generalized forces for external forces and for actuator-spring-damper element. Computation of reaction forces from Lagrange's multi- pliers

REFERENCES:

Wittenburg, J., *Dynamics of Systems of Rigid Bodies*, B.G. Teubner, Stuttgart, 1977.

Kane, T.R, Levinson, D.A., *Dynamics: Theory and Applications*, McGraw-Hill Book Co., 1985.

Nikravesh, P.E., *Computer Aided Analysis of Mechanical Systems*, Prentice-Hall Inc., Englewood Cliffs, NJ, 1988.

Roberson, R.E., Schwertassek, R., *Dynamics of Multibody Systems*, Springer-Verlag, Berlin, 1988.
Haug, E.J., *Computer-Aided Kinematics and Dynamics of Mechanical Systems-Basic Methods*, Allyn and Bacon, 1989.
Huston, R.L., *Multibody Dynamics*, Butterworth-Heinemann, 1990.
Schielen, W. *ed.*, *Multibody Systems Handbook*, Springer-Verlag, Berlin, 1990.
de Jalon, J.C., Bayo, E., *Kinematic and Dynamic Simulation of Multibody Systems*, Springer-Verlag, 1994.

P18 PEMD042	**CONDITION BASED MINITORING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive engines and Emissions, Engineering Chemistry, Automotive Pollution and its control, Fuels and Combustion.				
	Course Designed by : Department of MechanicalEngineering				

OBJECTIVES

To Understand the basic concept and to involve in replenishing the world through utilization of alternative fuels to meet over the current demand on energy scenario. The students can able to know the various alternative sources of energy other than fossil fuels and their significance.

COURSE OUTCOMES (COs)

CO1	to know and be able to explain the aim and the basics of CM be aware of some methods and procedures applied for general CM
CO2	appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring, know the general stages of CM;
CO3	be able to apply some basic techniques for analysis of random and periodic signals;
CO4	know the basics of Vibration of Linear Systems: time and frequency response, resonance
CO5	be aware of some basic instrumentation used for machinery and structuralvibration-based monitoring; be aware of some basic faults in rotating machinery, their manifestation and methods for detection and recognition: low frequency, medium frequency and high frequency

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

1	COs/POs	a	b	c	d	e
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

Unit 1.The basic idea of health monitoring and condition monitoring of structures and machines.

Some basic techniques.

Unit 2. Basics of signal processing: Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions of commonly found systems, spectral analysis.

Unit 3. Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals. Response of linear systems to stationary random signals: FRFs, resonant frequencies, modes of vibration,

Unit 4. Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments,

Unit 5. Typical applications of condition monitoring using vibration analysis to rotating machines, Some other health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications

M.Adams, Rotating machinery analysis - from analysis to troubleshooting, Marcel Dekker, New York, 01, ISBN 0-8247-0258-1.

Cornelius Scheffer Paresh Girdhar, **Practical** Machinery Vibration Analysis and Predictive Maintenance**,** Newnes, 1st Edition, 04, **Paperback ISBN:** 9780750662758

P18 PEMD043	**MEACHINE TOOL DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Automotive Engines and Emissions, IC engines and Alternative Fuels, Automotive Electronics				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

To explain the principle of engines electronic management system and different sensors used in the systems.

COURSE OUTCOMES (COs)

CO1	Understand the importance of tool design for productive manufacturing and the basic

	procedure of tool design, drafting of tool drawing etc.
CO2	Bring in the required properties in the tool material by proper selection and heat treatment appropriate to the cutting process adopted
CO3	Understand the concepts of tolerance and make use of gauges to measure the same Understand the design concepts of Jigs & Fixtures
CO4	Get proper knowledge in the latest area of tooling for CNC machines
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT – I **9**

Introduction – working and auxiliary motion in machine tools – parameters defining working motions of a machine tool – machine tool drives – hydraulic transmission and its elements – mechanical transmission and its elements – general requirements of machine tool design – engineering design process applied to machine tool – layout of machine tool.

UNIT – II **9**

Design of feed box – Machine tool driven using multiple speed motors – gearbox design – determining the number of teeth of gears – classification of speed and feed boxes – step less regulation of speed and feed rates.

UNIT – III **9**

Design of machine tool structures – design criteria for machine tool structures – material for machine tool structures – static and dynamic stiffness – profiles of machine tool structures – design procedure of machine structures – design of beds columns, housings, and boss of tables – model techniques in design of machine tool structures.

UNIT – IV **9**

Design of guide ways and slideways power screw, design of rails, arms, saddles and carriage – design of rams.

UNIT – V **9**

Design of spindle spindle supports.

Total Periods: 45

References:

1. N.K. Metha, Machine tool design and Numerical Controls, Tata McGraw Hill, 1998.
2. Sen, Bharracharya, Principles of Machine tools. New Control Book Agency (P) Ltd. Kolkata, 1995.

P18 PEMD044	**ADVANCED DESIGN OF PRESSURE VESSEL AND PIPING**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nanotechnology, Mechanics of Materials and Automotive Chassis				
	Course Designed by : Department of MechanicalEngineering				

OBJECTIVES

To Know about the Noise, Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles.

COURSE OUTCOMES (COs)

CO1	To understand the different types of stresses and their effects in pressure vessel
CO2	To understand the piping layout and the stresses acting on it.
CO3	
CO4	
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT – I

INTRODUCTION PRESSURE VESSELS & STRESS PATTERNS **9**

Methods of determining stress – (1) strain gauges (2) photo elastic method (3) moiré fringe techniques terminology – ligament efficiency – applications.

UNIT – II

STRESSES IN PRESSURE VESSLES **9**

Introduction – Hoop, longitudinal & radial stresses – general theory of maintain stresses – thin & thick cylinders – shell components – cylindrical shells – vessel heads – thermal stresses – discontinuity stresses in pressure vessels. Shrink fit – auto fuettage – ultrahigh pressure vessel design. Bursting pressure.

UNIT – III

DESIGN OF VESSELS **9**

Design of Tall cylindrical self supporting process column – supports short vertical vessels – stress concentration – variable thickness transition section in cylindrical vessels. Circular hole – elliptical openings – theory of reinforced openings – Bolted & Welded joints – Design criteria & codes.

UNIT – IV

BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon – Elastic budding of circular ring and cylinders under external pressure – collapse of thick walled cylinders of tubes under external pressure – effect of supports on elastic buckling of cylinders – inelastic collapse – Bulking under combined external pressure and axial loading. Interaction method.

UNIT – V

PIPING **9**

Introduction – Flow diagram – piping layout and piping stress analysis

Total Periods: 45

References:

1. JOHN. F. HARVEY. 'Theory and Design of Pressure Vessels.' CBSD Distribution 1987.
2. HENRY. H. BENDER. "Pressure Vessel Design Hand Book CBSD Publication and distributors 1987.
3. WILLIAM J. BEES 'Approximate methods design and analysis of pressure vessels and piping'. Piping Conference 1997

PROGRAMME ELEVATIVES -V

P18PEMD051	ADVANCED FINITE ELEMENTS METHOD	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Motor Vehicle Act and traffic Regulations				
	Course Designed by : Department of Automobile Engineering				

OBJECTIVES

To Learn and to enrich the knowledge on managing transport systems and to follow the rules and regulations of Motor Industry. Students might able to know the fundamentals and activities of transport systems

COURSE OUTCOMES (COs)

CO1	Demonstrate understanding of FE formulation for linear problems in solid mechanics Understand behaviour of elastic-plastic materials and visco-plasticity, Use of Newton-Raphson method for solving nonlinear equations of equilibrium
CO2	Understand flow rules and strain hardening, loading and unloading conditions,Drucker's stability postulates, J2 flow of theory of plasticity
CO3	Demonstrate use of FE formulation to solve the problems of large deformation of structures under load
CO4	Able to solve contact problems oby using the techniques of non-linear FEM
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L
	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

Unit 1. Review of linear FEA:

FE formulation of 1D bar, 3D linear elastic continuum, 2D plane strain, plane stress, and axisymmetric elements; Iso-parametric mapping; numerical integration.

Unit 2. FE formulation for 1D plasticity:

Elastic-perfectly plastic material; Isotropic and kinematic hardening; Integration algorithms for 1D plasticity; FE formulation; Newton-Raphson method for solving nonlinear equilibrium equations; 1D visco-plasticity and integration algorithm.

Unit 3. Continuum theories of plasticity:

Review of tensor algebra; Yield condition, flow rule and hardening rules; loading and unloading conditions; Drucker's stability postulates; Convexity and normality; J2 flow theory of plasticity and visco-plasticity, Gurson model.

Unit 4. FE procedures for 2D and 3D plasticity:

Integration algorithms for rate independent plasticity—explicit forward Euler and implicit backward Euler; Return mapping algorithm; visco-plasticity; FE

formulation; Consistent linearization; Algorithmic and consistent tangent modulii; Treatment of incompressible deformation (Locking); B-bar method.

Unit 5. FE procedures for large deformation problems:

Continuum mechanics—deformation gradient, polar decomposition, Green-Lagrange strain, rate of deformation, Cauchy stress, P-K stresses, Balance laws; Principle of objectivity and isotropy; Constitutive equations for hyperelasticity; Neo-Hookean model; FE formulation—Total Lagrangian and updated Lagrangian descriptions; Tangent Stiffness Matrix. Introduction to finite strain plasticity. Condition of impenetrability; Gap elements for modelling contact; Tangent stiffness matrix and force vectors for 2D frictionless contact problems

REFERENCES

K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited, New Delhi, 1996

J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer-Verlag New York, Inc., New York, 1998

O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, Fifth Edition, Butterworth-Heinemann, Oxford.

P18PEMD052	**Advanced Materials Science and Failure Analysis in Machine Design**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Materials scince				
	Course Designed by : Department of Mechanical Engineering				

OBJECTIVES

The objective of this course is to make the students to know and understand the production methods of various engine components like piston, connecting rod, crankshaft etc and various chassis components like friction lining materials, propeller shaft, steering column, gears etc.

COURSE OUTCOMES (COs)

CO1	Understand the structure and application of major mechanical engineering materials
CO2	Understand the elastic and plastic behaviour major mechanical engineering materials
CO3	Understand the types of failures of major mechanical engineering materials
CO4	Understand the design mechanical engineering materials against static and dynamic loads.
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
2	CO1	H	H	M	H	M
	CO2	H	H	H	H	M
	CO3	H	H	H	M	L

	CO4	H	H	L	H	H
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	47th Meeting of Academic Council-Aug, 2018				

SYLLABUS CONTENT:

UNIT I. STRUCTURE, PROPERTIES AND APPLICATION OF ENGG. MATERIALS 9

Metals, Alloys, Ceramics & Glasses, Organic Polymers, Smart materials, Super alloys,
Shape memory alloys, Nano materials, Super hard cutting tool materials, Crystalline and Non crystalline state
Composite Materials.

UNIT II ELASTIC & PLASTIC DEFORMATION OF MATERIALS 9

Point imperfection, Dislocations, Surface imperfection, Stress-Strain curve, Dislocation motion analysis.

UNIT III. FAILURE ANALYSIS OF MATERIALS 9

Types of failure of materials, Creep, Fatigue, Fracture analysis. Mechanism of failure and
Methods of protection against failure. Failure resistant materials.

UNIT IV DESIGN AGAINST STATIC LOAD 9

Factor of safety, Principal plane and principal stresses, Theories of failures, Stress concentration factors.

UNIT V DESIGN AGAINST FLUCTUATION LOAD 9

Endurance limits, S-N curve, Types of variable stresses, Soderberg equation, Goodman equation,
Gerber equation.

BOOKS:

1. Failure of materials in Mechanical design by J.A.Collins, A Wiley - Interscience publication.
copyright@1981 by John Wiley & Sons, Inc.
2. Material science and Engineering by V.Raghavan, 5th edition, 2012,
published by Asoke K.Ghush, PHI Learning pvt. Ltd.
3. Design of Machine elements, 3rd edition by V.B.Bhandari,
Tata.McGraw Hill education pvt. Ltd., New Delhi.
4. The Science and Engineering of materials, SI Edition, Donald R. Askeland, Pradeep P. Fulay, Wendelin J.

OPEN ELECTIVES

		L	T	P	C
P18OEBA001	**BUSINESS ANALYTICS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics
9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis
9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and

models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics
9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques
9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis
5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in
4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

		L	T	P	C
P18OEMA002	**INDUSTRIAL SAFETY**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

1. To study about the industrial safety and types.

2. To know about the tools and fundamentals of maintenance.
3. To study about the methods of wear and corrosion and their prevention
4. To know about the importance of fault tracing and its concepts.
5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety
9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, 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.

Module II Fundamentals of maintenance engineering
9 Hours

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.

Module III Wear and Corrosion and their prevention
9 Hours

Wear- types, causes, effects, wear reduction methods, 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

Module IV Fault tracing
9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, 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.

Module V Periodic and preventive maintenance
9 Hours

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

References Books:

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.

P18OEMA002	**OPERATIONS RESEARCH**	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

OBJECTIVES

To apply the dynamic programming to solve problems of discreet and continuous variables.

To apply the concept of non-linear programming.

An ability to carry out the sensitivity analysis.

An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques
9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method
9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex
method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM
9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow
problem - CPM/PERT

Module IV Server Models and Geometric Programming
9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory
models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical Analysis and Simulation of Game Theory
9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic
Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

		L	T	P	C
P18OEBA004	**COST MANAGEMENT OF ENGINEERING PROJECTS**				
	Total Contact Hours – 35	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction and Overview of Cost Management of Engineering
9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-
making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a
Costing System; Inventory valuation; Creation of a Database for operational control; Provision of

data for Decision-Making.

Module II ProjectCost Management
10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing
10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.

Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management
6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

		L	T	P	C

P18OEME005	**COMPOSITE MATERIALS**				
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction
9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements
9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites
9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites
9 Hours

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength
9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.

2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite – Nil				
	Course Designed by – Department of Automobile Engineering				

Module I Introduction to Energy from Waste

9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis

9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification

9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion

9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas

9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT I & AUDIT II

P18ACEN001	**AUDIT : ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS

Module I **4 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II

4 Hours

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module III

4 Hours

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV

4 Hours

Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V

4 Hours

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed

when writing the Discussion, and skills are needed when writing the Conclusions.

Module VI

4 Hours

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	**AUDIT: DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES:

Students will be able

- to Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and Programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

Module I Introduction

4 Hours

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Module II Repercussions of Disasters and Hazards
4 Hours

Economic Damage, Loss of Humanand Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module III Disaster Prone Areas in India
4 Hours

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module IV Disaster Preparedness and Management
4 Hours

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module V Risk Assessment
4 Hours

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module VI Disaster Mitigation
4 Hours

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	**AUDIT : SANSKRIT FOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS

Module I **8 Hours**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module II **8 Hours**

Order, Introduction of roots, Technical information about Sanskrit Literature

Module III **8 Hours**

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

- Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	AUDIT : VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

COURSE OBJECTIVES:

Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.

- Let the should know about the importance of character.

SYLLABUS

Module I
4 Hours
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

Module II
6 Hours
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Module III
6 Hours
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.Truefriendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.

Module IV
6 Hours
Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively.

Suggested reading
1.Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	**AUDIT: CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 24	**2**	**0**	**0**	**0**
	Prerequisite – NIL				
	Course Designed by – 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.

SYLLABUS

Module I History of Making of the Indian Constitution
4 Hours
History Drafting Committee, (Composition& Working)

Module II Philosophy of the Indian Constitution
4 Hours
Preamble, Salient Features

Module III Contours of Constitutional Rights &Duties
4 Hours
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.

Module IV Organs of Governance
4 Hours
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Module V Local Administration
4 Hours
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO 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

Module VI Election Commission
4 Hours
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 Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	AUDIT : PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making
- undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

SYLLABUS

Module I Introduction and Methodology

4 Hours

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

Module II Thematic overview

2 Hours

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module III Evidence on the effectiveness of pedagogical

4 Hours

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV Professional development
4 Hours

Alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

Module V Research gaps and future directions
2 Hours

Researchdesign,Contexts,PedagogyTeachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading:

a. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
b. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
c. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
d. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic bmaths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
e. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
f. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
g. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

P18ACYO007	AUDIT : STRESS MANAGEMENT BY YOGA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS

Module I **8 Hours**

Definitions of Eight parts of yog. (Ashtanga)

Module II: **8 Hours**

Yam and Niyam.Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module III **8 Hours**

Asan and Pranayam

i)Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

- Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also Improve efficiency

P18ACBA008	AUDIT : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS

Module I **8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's)

Module II

Approach to day to day work and duties. **8 Hours**

Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35
Chapter 18-Verses 45, 46, 48.

Module III **8 Hours**

Statements of basic knowledge.
ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. ShrimadBhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Suggested Reading

1. Srimad Bhagavad Gita, by Swami SwarupanandaAdvaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam,
New Delhi.

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity Study of Neetishatakam will help in developing versatile personality of students.